NOV. 1924 **RADIO BROADCAST** 35 CENTS

RADIO BROADCAST

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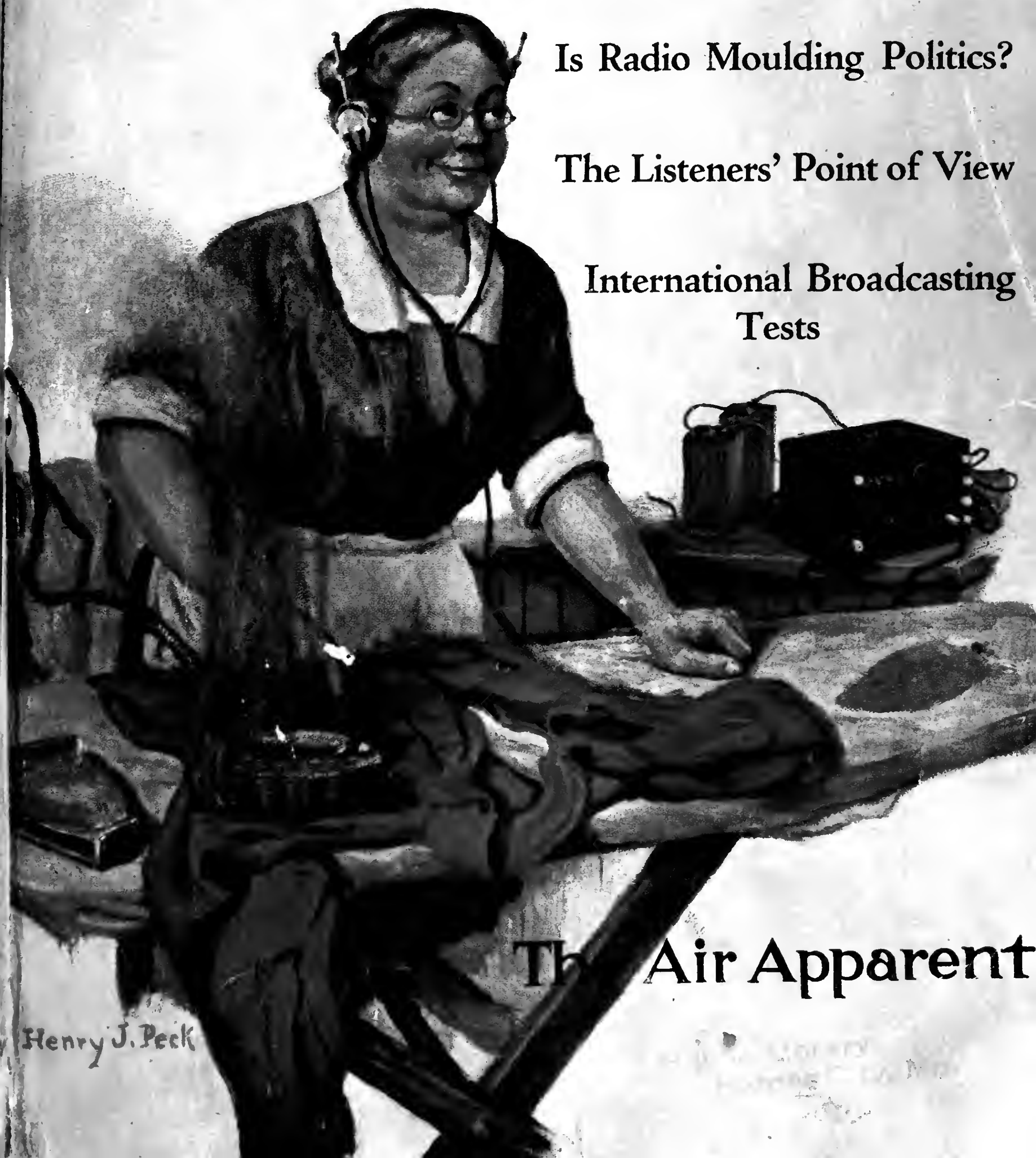

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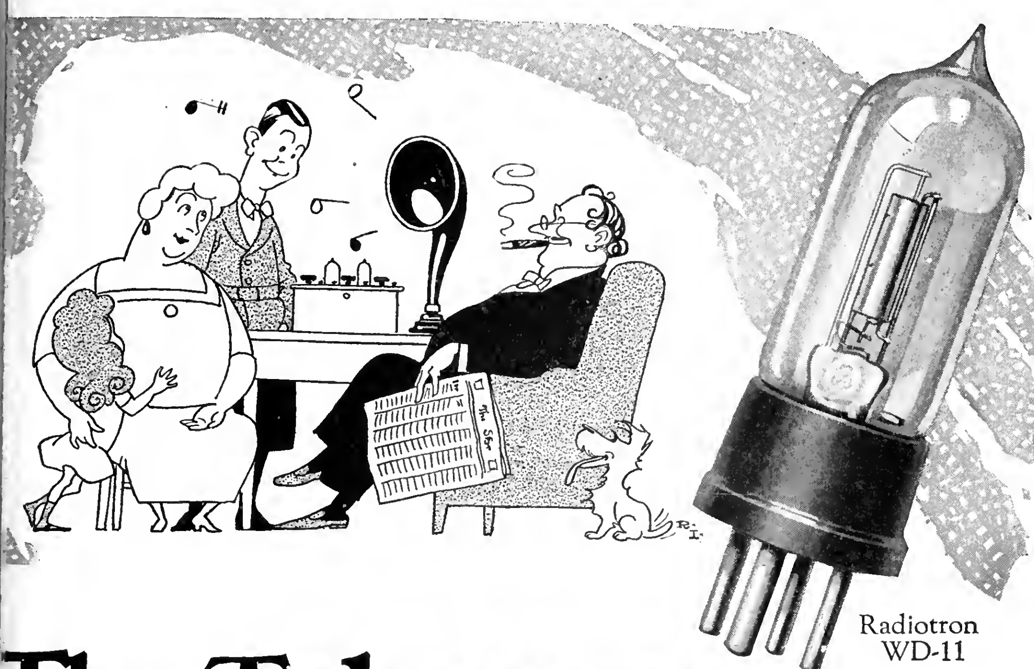

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RADIO BROADCAST

Vol. 6, No. 1 November, 1924

Will Radio Make the People the Government?

Democracy Is Government by Public Opinion and Radio Broadcasting is Bringing Politics Into the Front Parlor—Will Those Who Listen Vote?

By MARK SULLIVAN

ONE afternoon during the Democratic Convention in July, a Texas delegate remarked, "This will cost Texas a million dollars in its cotton crop through farmers staying away from the fields to listen in on the radio. But," he added, "it's worth it. It'll let everybody know just who's who and what's what in this convention."

Whatever accuracy his judgment may have had about the money involved, his deduction about the effect of the radio on that Democratic Convention was correct. There was one day in which the news of it might have been compressed by the practitioners of that most compact of arts, the headline writers into something like: "Western Radio Fans Listening-in On Convention, Hear New York Hiss Bryan, and Telegraph Delegates to Stand by Commoner." That quickness of response on the part of public feeling is going to be one of the effects the radio will have on politics. Coupled with its widespread use, its ultimate universality, it will work several political transformations. In political conventions, and in every other sort of political discussion, the thing most ardently desired by everybody who has confidence

JOHN W. DAVIS

Democratic candidate for President, campaigning by radio. Radio is aiding the people to find out just what each candidate says he stands for. Probably the most notable feature of the 1924 campaign is the use of radio by all three candidates

that his position has popular support, is quick access to that public, and facility for the public to express itself.

This increase of facility is one of the things the radio will bring about. Popular support existed to some extent before; and to the degree that it existed, it was the most powerful of political leverages. For the fact that Woodrow Wilson had a political career, the largest single contributing factor was an incident at the Democratic Convention at Baltimore in 1912. During all the early days of that convention, Champ Clark was in the lead, with Wilson a second, at one time so destined, apparently, to be permanently a second, that some of his advisers counseled him to withdraw, after Clark had pushed his leadership to the point of an actual majority. Just about that time, however, the convention adjourned over Sunday. During that week-end adjournment, the convention and the individual delegates were flooded with telegrams demanding that Wilson be made the nominee. It was through this pressure from the country that the Democrats took the unprecedented step of refusing the necessary two thirds to a candidate who had already got more than half the delegates, rejected Clark, and nominated Wilson.

BROADCASTING CONGRESS

THAT is the kind of thing that is going to be greatly accelerated by the radio. We have already had the radio for the first time this year in the conventions and in the acceptance ceremonies of the candidates. Undoubtedly the proceedings of Congress will soon be broadcast, I think. A public that got so much interest out of the Democratic Convention will insist on the same access to Congress. And Congress as a whole won't be disposed to deny it. There is already a bill pending providing for the installation. The bill was introduced by Senator Howell of Nebraska. Senator Howell was one of the very earliest radio zealots in America. He was acutely interested in it and active about it long before most of us paid any attention to it. Senator Howell has a scientific thread in his training that he got from his education at the Annapolis Naval Academy. Also, he is a most earnest believer in the public ownership and management of utilities that concern the public generally. Before he came to the Senate he was, as the manager of the city gas system of Omaha, one of the earliest, and possibly the most successful, director of a publicly owned utility in the United States. Senator Howell heard about the use of the radio in Europe quite early, and some three years ago made a trip to Vienna to study its working in that city. He thinks strongly that the radio should be facilitated in every possible way as a medium between the people and the Government. Due to his own bent and experience, he would take an earlier and longer step toward identification of the radio with the Post Office, for example, than most of his fellow senators now think practicable or desirable. Short of that, however, there is little doubt that his bill to equip the two Houses of Congress for the broadcasting of speeches and other public business will be adopted. I don't know of any public man who opposes the idea of the maximum possible radio dissemination of all forms of public business and public discussion. If any of them have qualms, they won't state them publicly, for they know it is an innovation that cannot be stopped. Theoretically, a politician may believe in some other form of government than through public opinion or public emotion. But practically they know that it is the form of government that is now here. And if you assent to the principle of government by public opinion, you must assent also to the doctrine that the wider the dissemination of public information, and the greater the number of persons enabled to participate in the formation of common judgments and common reactions in the shape of emotion, the more logical it is.

HOW IS RADIO GOING TO BALANCE POLITICAL FORTUNES?

POSSIBLY we shall have some erratic, some curious and unanticipated results in the fortunes of individual politicians and leaders. There appears to be such a thing as a radio personality. In the present campaign it is claimed that Coolidge has it, while Davis has not. A correspondent of a Democratic paper, Mr. Charles Michelson of the New York *World*, wrote about this:

> Mr. Coolidge is no orator. There is a wire edge to his voice, due in some degree to the regular nasal twang of the thirty-third degree Yankee and in part to his meticulous enunciation of each syllable; but according to the professors of the new art, he has a perfect radio voice. The twang and shrillness disappear somewhere along the aerial, and he sounds through the ether with exact clearness as well as softness. Mr. Davis, on the contrary, has a voice which to the direct auditor has that bell-like quality of resonance that doubles the

quality of his delightful rhetoric. Via radio, however, this muffles and fogs to some extent. The radio was perfected just in time for Mr. Coolidge. His adversary has all the best of it in presence and personal magnetism. Davis is tall, with a face that would fit in a group picture of the signers of the Declaration of Independence and features like an idealistic medallion. Coolidge looks shorter than he is; his features are sharp and give a probably unjust impression of peevishness. Before an audience Davis glows, while the President always looks unhappy whether he is or not. Under these circumstances, the radio must be Mr. Coolidge's salvation. He doesn't look as if he had the physique to stand the strain of an old-fashioned campaign—half a dozen speeches a day and traveling every night for months—in the first place, and in the second his hard, statistical, analytical method of expression is scarcely calculated to counterbalance the unimpressiveness of his appearance. So the advent of radio must be listed as one more item in the total of the Coolidge luck or destiny or whatever it is that seems to make things come right for him politically.

Who Is the Government?

Some pessimists like to think it is the Senate, some the House, more think the Government is the President, and some few seem to think it is the Supreme Court. But when the broadcasters began sending out the Republican and Democratic conventions, the political observers with their ears to the political ground began to wonder. It took no seer to observe that the "peepul" were again taking an interest in politics. And during this campaign, very largely being conducted by radio, politics is prowling right into the front parlor.

What is going to happen? Mark Sullivan, who contributes a political article to *World's Work* each month, and whose daily stories from Washington in the New York *Herald-Tribune* are counted some of the most authoritative and interesting in the field of political writing, considers these questions:

—Is Congress Going to Broadcast?

—What Is Radio Personality?

—Can Broadcasting Replace the Congressional Record?

—What Is Going to Become of the Old Line Political Speaker?—The Editor.

ARE OUR SPEAKERS GOING TO BE DIFFERENT?

I HAVE speculated a good deal, without arriving at any very competent conclusions, about what the effect of the radio will be on Congress as a whole and on individual politicians. Just what type of public speaker will the people prefer to listen to? One of the premier Marathon talkers in the Senate is Heflin of Georgia. Without having measured the lines in the *Congressional Record*, I should say off-hand that Heflin is one of the greatest long-distance speakers, one of the most nearly ever-flowing fountains of words, in public life. When a newspaper man hurries into the press-room on his way to the gallery, fearing he may be missing something important, and finds the bulk of the newspaper men chatting in the ante-room, the explanation they most generally give him for their temporary retirement is that "Heflin is talking." Or they remark, "There is nothing important on. Heflin is delivering the twenty-third installment of his attack on the Federal Reserve Board."

As it happens, it is the depraved taste of the writer of this article that elevates him to the distinction, rather uncommon among newspaper men and among senators, of liking to listen to Heflin talk. Heflin is not a beautiful person, but he has two engaging qualities: He has that agreeable intonation of the South—and he can tell Negro stories better than any other man in public life. I would venture more and say that Heflin can tell more Negro stories and better ones than any professional entertainer. Heflin knows the difference between a stage-carpentered Negro story and the true Negro story, the kind that reflects the real soul, the habit of thought, the way of looking at things, of the genuine unsophisticated Southern colored man. And Heflin doesn't tell his stories merely for the sake of being amusing. He adapts them to the situation he is discussing with an art that is often rather more effective than heavy logic.

As to the soundness of Heflin's economics, or the high-mindedness of his political arts, there is some difference of judgment. They tell a story about Heflin. That is, they repeat something that Heflin is alleged to have said on the stump in Alabama some years ago. I never heard Heflin address an audience of Alabama farmers in the hills far back from the railroads. I should like to. For there, I should imagine, Heflin would be at his best. In any event, disavowing personal responsibility for the authenticity of the story, I repeat it in the same spirit in which Heflin repeats his

stories about Black Sam and Mollie the cook. Heflin made a campaign for the Lower House in the year at the beginning of the War, when cotton was at six cents a pound. Then he made his appeal for the Senate in 1918, when the war-time demand had got under way and raised the price of cotton to upward of thirty cents a pound. All this economic and political history Heflin is alleged to have summed up to the Alabama farmers in a passage running thus:

"You good folks, you-all sent me to the Lower House of Congress when cotton was six cents a pound, and then you saw cotton go right straight up to thirty cents a pound. Now, good folks, you send me to the Upper House of Congress, to the high-up place—you send me to the Senate, and then you watch where the price of cotton will go to."

Unhappily it was soon after Alabama elevated Heflin to the Senate that the War ended and cotton descended rapidly to under ten cents a pound—which unkind reversal of fate, some members of the Federal Reserve Board believed, had more than a little to do with Heflin's Senatorial attacks on them as the authors, according to his theory, of the deflation of the price of cotton.

SENATORIAL NEGRO STORIES BY RADIO?

WILL the radio audiences want to listen to Heflin's Negro stories? Or will they prefer the less ornate, the less mellow and mellifluous but rather more austerely accurate facts and figures of a speech on the tariff by Senator Smoot? If the radio audience has the same reaction as the personal presence audience, it should work out all right. Last winter the two senators whose speeches were most certain to draw an audience to the Senate galleries were Borah of Idaho and Walsh of Montana. In those two cases, the size of the gallery audiences were in direct proportion to the fundamental merit of the speeches and the speakers.

A good many questions will arise about distribution of time. We have already seen that the radio is making its own imperious demands about a preferred hour. In 1920, before the radio came, the two candidates for the Presidency, Cox and Harding, both timed their acceptance speeches for the afternoon, because from three to five o'clock were the hours most convenient for the greatest number to be there in person. This year both the candidates timed their acceptance speeches with a view, not to the audience, that could actually be there, but to the radio one. Eight o'clock in the evening, in the Eastern territory where population is densest, seems to be the hour accepted as best adapted for the largest number of radio listeners. Presumably, when the radio reaches into Congress, that will be the most prized hour. If it is, there will result a change in the hours of the sessions for the common system now, except in the congestion at the end of a session, is for Congress to sit from eleven in the morning until five in the afternoon.

Let the Non-Voter Beware

For this year, great efforts are being made to bring the sluggish voter to the polls. With radio interesting great additional groups of citizens in the affairs of government, many organizations are pushing a "Get-Out-the-Vote" campaign. The National Association of Manufacturers is coöperating with the American Radio Association to appeal to the voter by radio and by newspaper announcement. And the Boy Scouts of America are going to make a personal canvass designed to reach every voter. James E. West, Chief Scout Executive, says in a letter to RADIO BROADCAST, "It seems to us that this problem offers the Boy Scouts of America an excellent opportunity for applying its method of 'learning by doing' by having scouts make an earnest effort to increase the voting average of their respective cities and towns, beginning with their own homes and neighborhoods, entirely on a non-partisan basis." There are many who think that the noticeably increased interest in practical politics is due in a large measure to radio. —THE EDITOR.

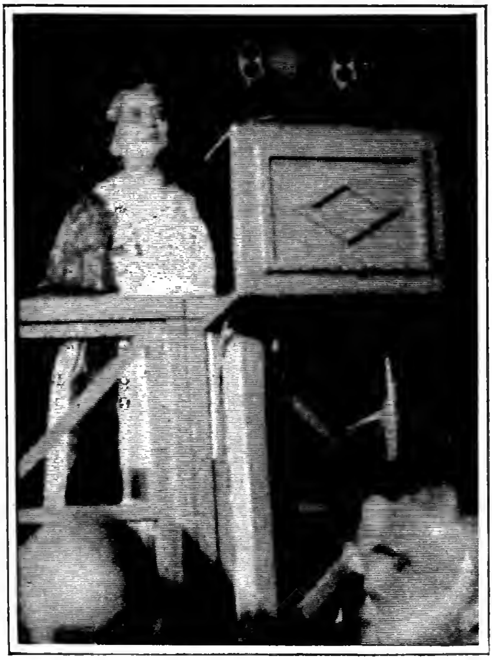
CONGRESS WILL BOW TO RADIO

THAT mere change of working hours will be minor compared to complications about assigning the preferred hour to the speakers who will want it. Probably the outcome will be a wholesome increase in the potency of party leadership. It would seem probable that with the radio installed, each party will tend to gravitate about one leader or a small group of leaders, and will tend to give these leaders the preferred hours for the formulation and dissemination of official party policy. One hopes that there will not be too much disposition on the part of the radio listeners to give their ears to the entertaining

speaker rather than the sound one, or the ones chosen to give official expression of party policy. One wonders just how it will be determined what speakers the radio listeners want to hear—and what ones they want to "walk out on."

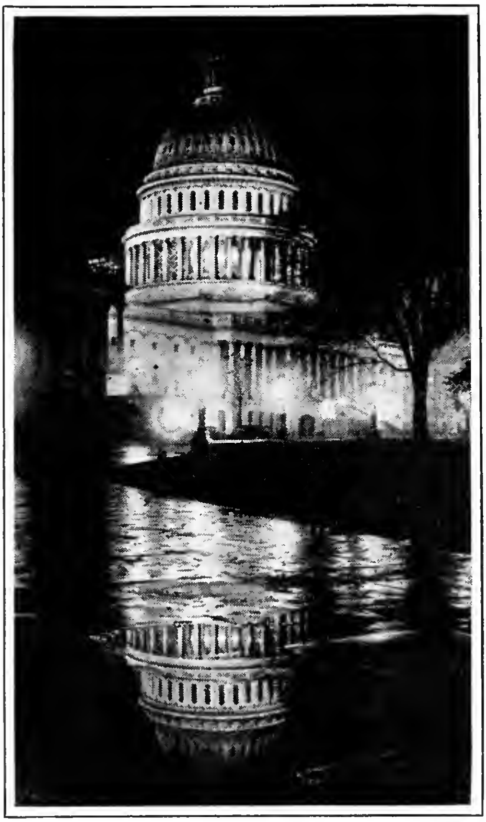
RADIO NEEDS A "GET OFF THE EARTH" SIGN

THE radio so far provides no means for the listener to shout "Get Off the Wire!" or "Get Off the Air!" or "Get Off the Earth!" or whatever else it is that an irritated radio listener should say to a politician who bores him, or excites his opposition. Of course, the radio listener, so far as he is concerned individually, has the most effective possible means of giving a boresome speaker permission to "take the air" in another than the radio meaning of that phrase. All the listener has to do is to turn his dials and put his mind on the more agreeable harmony of a concert. The difficulty is, that this method lacks a certain kind of personal satisfaction. It does not provide the listener with a mechanism for conveying to the speaker the information that the listener is through with him. It fails to give the listener that agreeable and wholesome outlet for a surging emotion that comes from rising in his seat and marching stiff-necked toward the door. At the same time, it has compensations for the less combative and the more courteous. From a radio audience you can tiptoe your way out without suffering the embarrassment of the feeling that you may be disturbing your fellow-auditors.



A TELEPHONED PHOTOGRAPH

Of the Republican convention at Cleveland. The linking of wire photography and broadcasting has brought the Nation in almost immediate touch with political events. Mrs. Florence C. Porter, of California, is seconding the nomination of Calvin Coolidge. The microphones can be seen at the top of the lectern



NIGHT SESSIONS OF CONGRESS

Will become very important if the legislative arm "speaks" through the microphone, for only a comparative few could listen during the daylight hours

YOU CAN'T FOOL THE RADIO

THE fundamental merit of the radio in Congress will be that it will enable the public to get its information direct. At present, aside from those speeches from men who, because of one distinction or another, have all their speeches printed in full—aside from these, the public is now dependent on the vicarious censorship of the newspaper re-

porter. It is the reporter who ignores some speeches, makes mere allusions to some, and transmits extracts from others. In all this exercise of judgment or taste, there are the aberrations that inevitably accompany any individual judgment. Undoubtedly one of the chief defects of the present method of reporting Congress is that it lays undue emphasis on the bizarre, the picturesque, the humorous, or the sensational. These, frequently, are the high spots picked out of speeches by the reporters, and therefore the only portions of the speeches that ever reach the great mass of the public. This is a constant and legitimate occasion for complaint on the part of public men.

I once spent some weeks at Carlsbad. It was a time when the proceedings of Congress were unusually important, and when I happened to have unusual interest in them. Again and again, in the dependence on the newspapers enforced by that exile in Europe, I was impressed with the inadequacy of the information I could get through the newspapers. I recall one day when the only news of our Congress in the European edition of an American paper consisted of a brief account of a personal controversy the late Senator Penrose of Pennsylvania had with a fellow-senator. The only direct quotation transmitted was a bit of caustic sarcasm.

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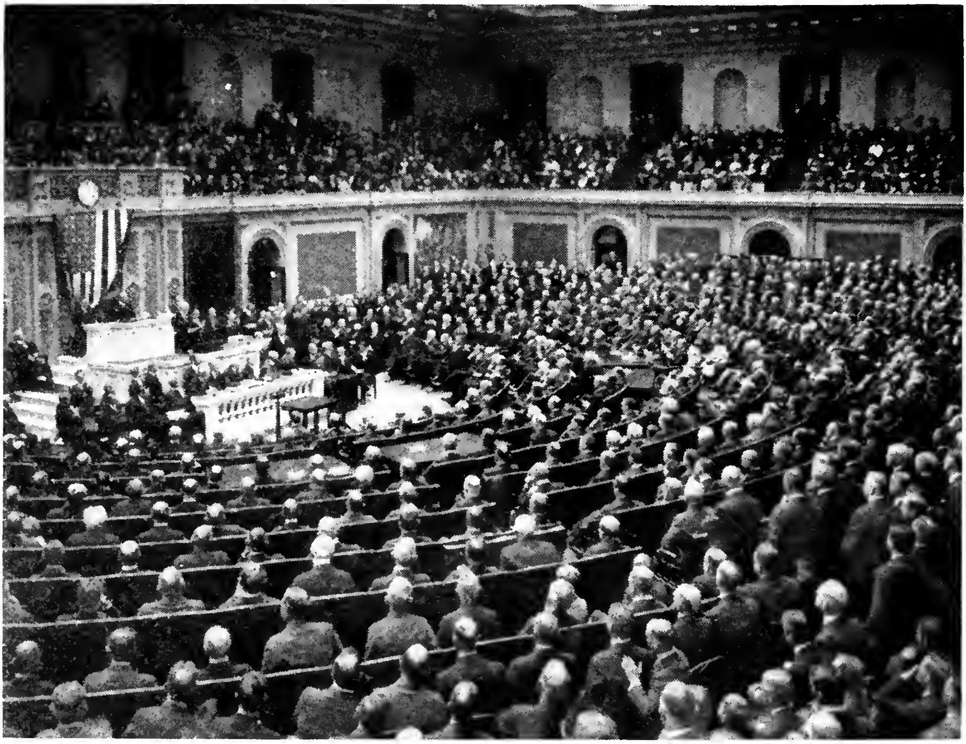
HENRY MORGENTHAU

Before a microphone in New York. Public men welcome the opportunity to address and interest the greatly increased audience the radio gives them

RADIO: DEMOCRACY'S FINAL SUPPLEMENT

WITH the radio, all this will be changed. The person who wants to listen to Congress will be able to do so, and there will be many who will want to listen. Let there be no doubt of that. There has always been in this country an immense unfilled demand in this field. I have heard it said by a competently thoughtful person that the absence of complete reports of the proceedings of Congress in a form and with a promptness available for all the public, was a real impediment to the functioning of our American democracy, an impediment so serious that it might be adequate cause for apprehension. In London, the proceedings of Parliament, with comparatively little condensation, and with only such editing as makes for clarity, are printed in full in at least three morning London newspapers. In America we have nothing like that. The nearest we have is the case of two or three New York papers which print a few speeches in full, and have a condensed summary of the rest. The reason for the difference between England and the United States is not any lack of thoughtful interest on the part of Americans in their national legislature. Americans read much more and support many more newspapers in proportion to population than the English. The difference is largely mechanical and geographical. So far as regards proceedings of Parliament in the newspapers, all England is practically one city. The British Parliament is in the largest city, whereas our Congress is in one of our relatively small cities. More than this, a London newspaper that goes to press at two o'clock in the morning can be in the hands of readers in the most distant hamlet of the Kingdom before evening. With us, California is some four days distant from the Capital, and the cost for telegraph tolls to a San Francisco newspaper that might be ambitious enough to print all the proceedings of Congress, would be prohibitive.

To offset this difficulty of ours, William Jennings Bryan and some others have repeatedly proposed some kind of official newspaper that should, through the machinery of a non-partisan Board of Editors, make and distribute an adequate official summary of the work of Congress. That idea has been proposed again and again. It has never got anywhere, for the reason, among others, that a Board of Editors sufficiently non-partisan to satisfy everybody is a dream impossible of



WHEN SHALL WE LISTEN-IN ON THE GOVERNMENT?
Mark Sullivan thinks that the time is not far distant when the proceedings of Congress will be broadcast. The average newspaper cannot give full reports of the two Houses, and the *Congressional Record* reaches but a few of the people

realization. The only thing that would meet, without criticism, what Bryan had in mind, would be a literal transcript. We already have a literal transcript in the shape of the *Congressional Record*. With that, the difficulty is its rather too great literalness. It includes such immense masses of irrelevant quotations introduced under "leave to print," and so much parliamentary minutiæ about resolutions and the like, that it is forbidding, even to a reader with the most ardent desire to follow the proceedings of his government with intelligence. I find it a strain to read the *Congressional Record*, and it is a part of my business to do so. The consequence is that of the aggregate circulation of the *Congressional Record*, which is something like thirty-two thousand, the bulk, under the system of distribution now practised, goes to little country newspapers as a complimentary gift from the local congressman; and finds its ultimate usefulness more in providing little print-shop stoves with fuel, than in the information of the public.

CAN STATIC INTERFERENCE BE ELIMINATED?

WALTER VAN B. ROBERTS has written a discussion of this much discussed subject that is as informative as it is interesting. What are the engineers doing to eliminate the present difficulties? What are the most productive lines of experiment? What results are likely to occur from the present line of investigation?

The Ways and Means of Audio-Frequency Amplification

Applying the Family Tree Method to a Non-Technical Treatment of this Highly Important Adjunct to Radio Receivers

By JULIAN KAY

THIS is the third article by Mr. Kay in the "What's In a Name?" series. The first article appearing last June, sorted out and classified the various types of radio receivers in present use. The second, in July, told the story of radio-frequency amplification. It is no secret that many new members of the radio fraternity glibly use terms of whose meaning they have not the slightest idea. The articles in this series, each a complete unit, by the use of the unique and helpful Family Tree diagram, and a praiseworthy non-technicality of treatment, aim to clear the radio air for those who find it a bit thick.—THE EDITOR.

THE criteria by which an ideal radio set is measured are two: distance and clarity. Both of these prime qualities are attained through the proper kind of amplifiers.

Preceding articles of this series have discussed the merits of various detectors, that essential radio "ear," and the means of aiding a detector to eavesdrop over a wide area—namely, radio frequency amplifiers—were explained. The super-heterodyne will be cited in a succeeding article and discussed as the most efficient combination of radio receiving apparatus known to-day.

Radio sets are now nearly complete. One can listen over great distances, and so far at least, what we hear is a fairly accurate representation of what is being transmitted at the distant station. The final problem is to supply "pep" in sufficient quantity and in such a manner that what is heard is still something like what is being transmitted.

Fig. 1 shows the position of audio-frequency amplifiers in the usual radio circuit. These amplifiers derive their specific name from the fact that they follow a detector. In other words, they appear in the low or "audio" frequency part of the circuit. The band of frequencies which they will be called upon to amplify lies between about 100 and 5,000 cycles per second.

The careful construction of an audio amplifier is really more important than most radio fans appreciate. To rush out to the corner radio shop, to grab a cheap transformer, and to jam the parts together is not the way to make a good amplifier.

There is still a morbid inclination among certain of the *nouveau* radio public which takes the indefensible form of boasting of listening to respective sets a half dozen blocks up the street, and the thrall of hearing horribly distorted music over a distance of a thousand miles seems to hold many. The fortunate tendency, however, is toward "how well" one hears rather than "how far" or "how loud."

An amplifier as the name implies, is anything that returns to you with interest whatever you give it.

Do You Know—

—How to judge a good amplifier?
—What audio frequencies are?
—How much an amplifier amplifies?
—What types of audio frequency amplification there are?
—How "quality" and "quantity" both can be secured from an amplifier?
—Why the "frequency characteristic" of a transformer is important?
—What the function of the C battery is in an amplifier?
—What a power amplifier is?

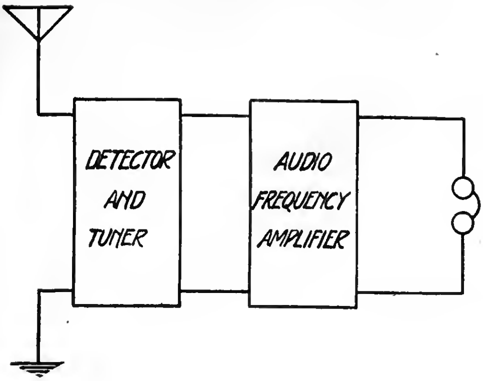


FIG. 1
Audio frequency amplification comes after the tuner and detector

A savings account, or a prize fighter incognito, are good examples. The particular type of amplifier in which we are now interested is a vacuum tube affair, like most of our present day radio equipment, and is one of the most uncomplaining contraptions that man has produced. As long as you do not treat it too roughly it returns to you with interest exactly what you give to it.

The motto of a well behaved amplifier stated in classical language might well be:

"Small favors thankfully received and large ones granted in return."

It amplifies, some "an hundred fold" and then some more.

TYPES OF AUDIO AMPLIFIERS

THERE are two general classes of amplifiers in which we are interested. These two divisions depend upon the matter of coupling two or more together. As the Family Tree shows, the first large group is made up of those which are "conductively coupled," that is, in which the output of one amplifier and the imput of the next are actually connected together either by a metallic conductor or by means of a condenser. The second group depends for the transfer of energy from one unit to the next upon magnetic coupling existing between the two windings of a transformer.

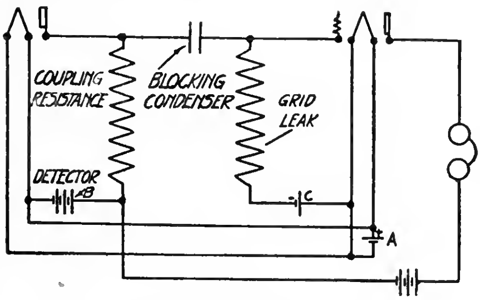


FIG. 2
A resistance-coupled amplifier unit

Resistance-coupled amplifiers, of which the general type is shown in Fig. 2, have one great advantage—(if properly constructed) in that they are distortionless. On the other hand, there is one great objection which has not as yet been overcome—they require much higher voltage B batteries for the same amplification than do the transformer or choke coil-coupled types.

If a choke coil is substituted for the resistance, the B battery objection is partially remedied, but the amplifier now has a "frequency characteristic," that is it tends to amplify some frequencies more than others with a resultant distortion. This may, however, be overcome by proper design.

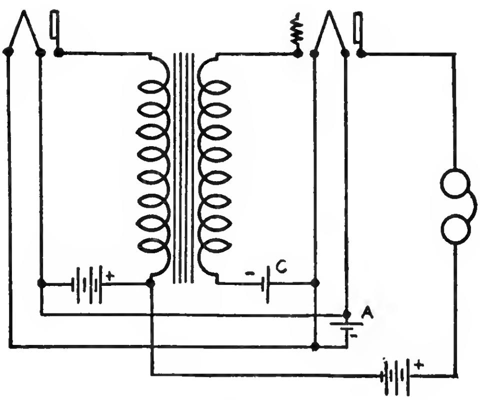
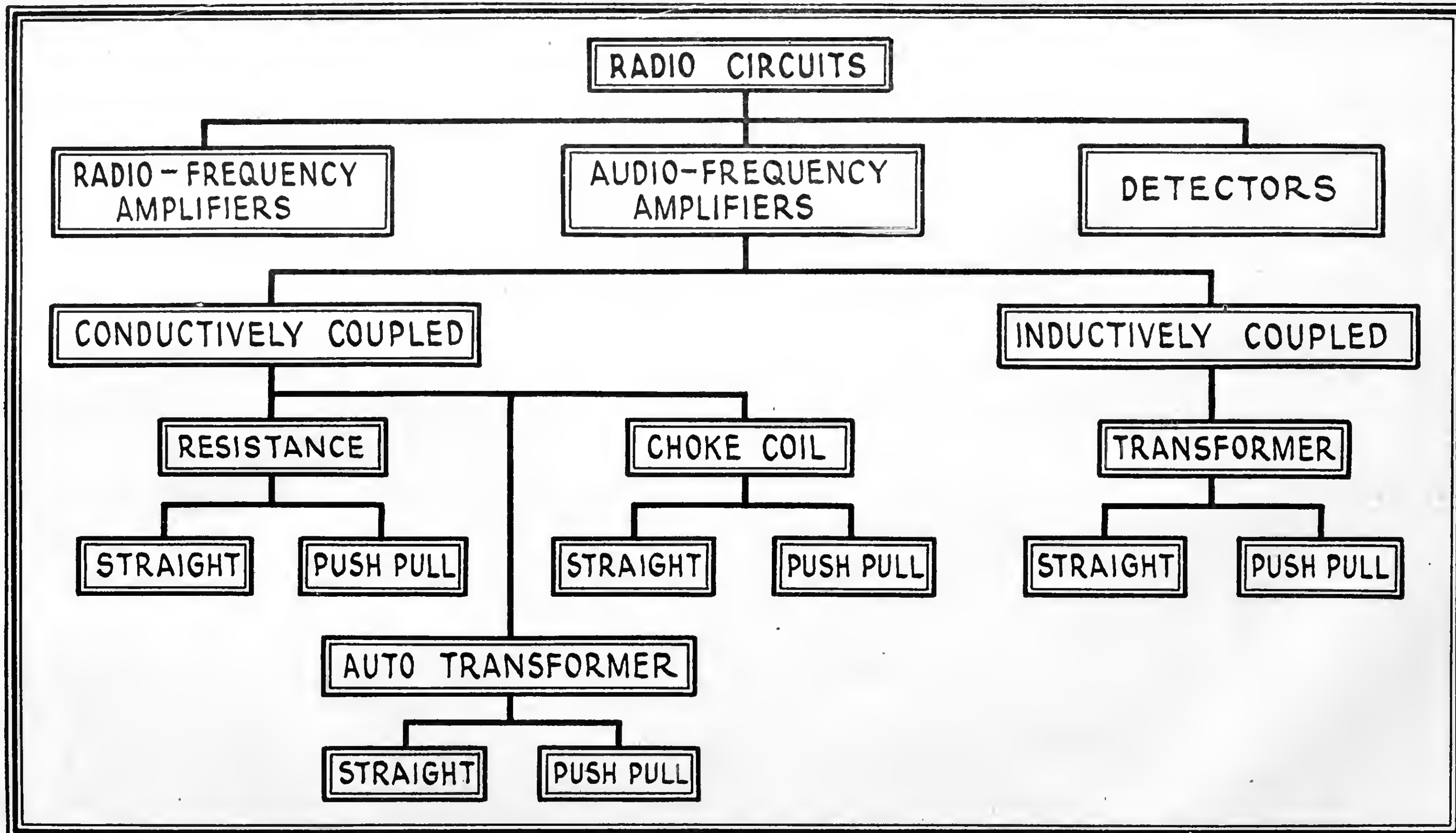


FIG. 3
A transformer-coupled amplifier. Note the use of the C battery

TRANSFORMER COUPLING

AT THE present time, the transformer is the all important link between signals that are detected and signals that are actually heard. Upon its efficiency depend the quantity and the quality of the music we hear. Unfortunately, quantity and quality seldom come in the same package, and in the case of the usual amplifier, when you have one you want the other and vice versa. And it is possible to have both.

Fig. 3 shows the customary transformer-coupled amplifier. In this diagram, the transformer looks like a simple and guileless piece of electrical apparatus—just two coils of wire on an iron core—but as the quaint saying goes:



THE FAMILY TREE FOR AUDIO FREQUENCY AMPLIFIERS

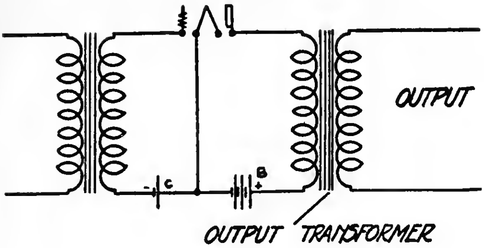


FIG. 4
How an output transformer is used

"You haven't heard the half of it."

QUANTITY VERSUS QUALITY

THE two aspects of the amplification problem—quantity and quality—are indissolubly bound up in the transformer. The first is controlled to a great extent upon what is known as the "turn-ratio." For instance, if the secondary has ten times as many turns of wire as the primary, the turn-ratio will be ten, and at the secondary terminals will appear ten times the voltage that was applied to the terminals of the primary.

If we use a vacuum tube with an amplification factor of six, the overall amplification of this combination—theoretically at least—ought to be six times ten or sixty. Actually, this is not realized since half of this voltage is consumed in the tube itself.

At this point, the question naturally arises, why not use a turn ratio of fifteen or twenty?

The answer lies in our discussion of the second amplification problem, "quality" or clarity, as it is often called.

QUALITY AMPLIFICATION

THE "frequency characteristic" of a transformer is a measure of how well the device will transmit various frequencies.

When we realize that we are amplifying musical sounds of frequencies that may lie anywhere between 100 and 5,000 cycles per second, and that each individual frequency should be reproduced for us exactly as they are transmitted, we see the value of a "flat characteristic."

Fig. 7 shows the characteristics of two audio transformers, the other apparatus being the same in the two cases. One transformer transmits all frequencies very much alike, while the other gives a tremendous amplification around a thousand cycles. Such a transformer would not give accurate reproduction and would probably present any soprano as nothing better than a terrible squawk.

Any one can make a transformer that will have a "hump" around 1,000 cycles. In fact the majority of cheap transformers enjoy such camel like humps.

The difficulty is to make an instrument with a flat frequency characteristic. If we strive for high quantity amplification, we must use many turns on the secondary, and that means a large distributed capacity which in turn means that the high frequencies will be lopped off and will not get through. If we make a cheap transformer, we economize on core and wire, and as a result the primary has a low inductance. Accordingly, the low frequencies are cheated.

And there you are.

To make a good transformer costs good money and the manufacturer must compromise. He is between the devil and that awful deep sea. If he is reliable, he makes a low ratio coil, which keeps down the distributed capacity and amplifies the high frequencies, and puts as many turns on the primary as he can afford, which brings in the bass viols and drums, and then juggles the remainder of the apparatus until he gets a good characteristic.

If people were willing to pay, say ten or more dollars for a transformer, they might get quantity and quality at once, say a high ratio transformer with a flat characteristic, but, in the immortal words of the prophet,

"What a pity we weren't all born rich."

OVERLOADING

THERE is another important aspect to the high turn-ratio coil that deserves more attention than is usually paid to it. This is the phenomenon known as "overloading," which takes place as soon as the grid of an amplifier tube becomes positive. Figs. 4 and 5 show one method of overcoming this trouble which is evidenced by "blare" and flattening of notes when an especially loud signal comes through.

Suppose, for example, that the grid of an amplifier is normally maintained at a negative potential of five volts. As soon as the voltage

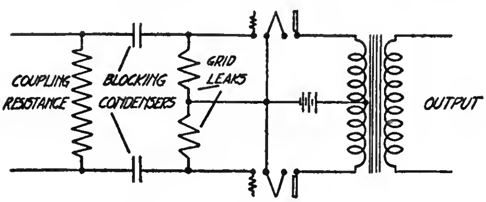


FIG. 5
The way a resistance-coupled push-pull amplifier unit is built

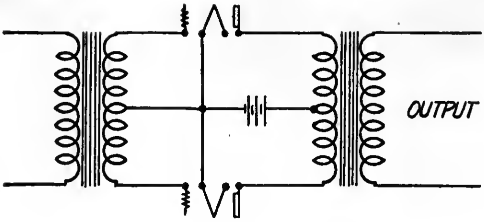


FIG. 6
A transformer-coupled push-pull amplifier. This type is quite generally used and produces much volume

applied to this grid is greater than incoming signals by five volts, the grid becomes positive during one half cycle. The result is that the positive and negative halves of the incoming signals are not amplified alike and distortion occurs.

Here is where the C battery comes in, as shown in Fig. 3. It serves two purposes, to place a negative potential on the grid and thereby to advance the overloading point, and to decrease the drain on the B batteries.

It is worth while to note at this point that a high ratio transformer with a hump near 1,000 cycles may overload at that point only—which may explain some of the wondrous squawks that occasionally greet us. Often a horn has a resonance point in the same neighborhood as the hump of the transformer, and what a wicked racket these two phenomena may produce!

Listen to any of the cheap horns that hang outside the average dinky radio shops, and then judge for yourself, if you can still think after the experience.

Another method of eliminating distortion due to overloading, is to use large tubes, say a Western Electric 216-A, and then more C and B battery voltage. Or, a push-pull amplifier of the resistance, or transformer-coupled type, as shown in Figs. 4 and 5. A resistance-coupled push-pull amplifier, which has no frequency characteristic and also quite a power capacity because of the push-pull feature, makes a good last stage in such an amplifier unit.

HOW MUCH AMPLIFICATION HAVE I?

THE overloading limit, then, is the input voltage at which the grid goes positive. This point is controlled by the kind of tube, the C battery, and the turn-ratio of the coupling transformers.

In general, the following rule may be a safe one to follow:

Any signal that can be heard with the phones plugged into the detector circuit will overload the last stage of a properly constructed two-step amplifier using "five-to-one" transformers. Fig. 7 shows exactly what this means.

Suppose each tube has an amplification factor of 6, and the turn-ratio is 5. Then the overall amplification, taking losses into account, may be around 150. An alternating current then flows in the plate circuit of such an amplifier which is 150 times that which flows in the detector circuit. If only .006 volt alternating current exists in the detector, then we must use about 9 volts negative potential on the grid of the second amplifier.

POWER AMPLIFIERS

SO FAR, we have spoken only of "voltage amplifiers." Now, then, what is a power amplifier? One hears the term very commonly used. Now it is power that runs our loud speakers, not voltage alone, and power is usually represented as the product of a current squared and a resistance. For example, if the resistance of a loud speaker element is 1,000 ohms and we have .001 ampere flowing through it, the power

$$P = 1{,}000 \times (.001)^2 = .004 \text{ watts.}$$

That means that an amplifier that is to deliver music for a large hall must have a comparatively large plate current output. This means large tubes with large plate currents, for it is the fluctuations of these plate currents that actuate the receiving device.

The last stage of a good amplifier may well be a power amplifier employing a low ratio coil, say three to one, and a large tube such

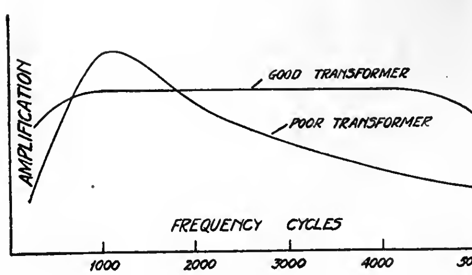


FIG. 7
A curve which shows the difference between a good audio-frequency transformer and a poor one. As the curve shows, a good audio transformer should amplify well over the entire range of audio frequencies, an end extremely difficult to attain

as the Western Electric 216-A. Better still is the push-pull already described in RADIO BROADCAST which has a very high overloading limit and a larger power output.

If one is to listen-in after the first stage of audio-frequency amplification, the high ratio coil should come first, but if a horn is to be used at all times on the second stage, it matters little the order of the transformers. If there is enough voltage to overload the last tube, it will take place regardless of whether the high ratio coil is in the second stage, or whether the coils are switched. The amplification is there in either case.

As stated previously, the ideal arrangement would be a single stage of resistance coupling followed by a push-pull amplifier with plenty of B and C battery. Finally should come a good loud speaker, usually coupled to the amplifier with an "output" transformer. Neither of these two stages of amplification would introduce noticeable distortion, and if a good horn is used, reproduction should be as faithful as is normally possible.

RADIOLATRY

By ARTHUR GUITERMAN

THE worst of all idolaters
Are zealous radiolaters
Who wreck the peace of erstwhile happy homes
With drool of variometers,
Detectors, galvanometers,
Antennae, switches, batteries, and ohms.

Their eyes devoutly glistening,
They'll sit for ages listening
With clumsy rubber muffs upon their ears,
And hail the shrieking mordancies
Of far-away discordancies
As though they were the music of the spheres.

They'll stand for prosy summaries
And monologues and mummeries
Of folks you couldn't wheedle them to see,
The rant of revolutionists,
And awful elocutionists,
Because they come from Newark, XYZ.

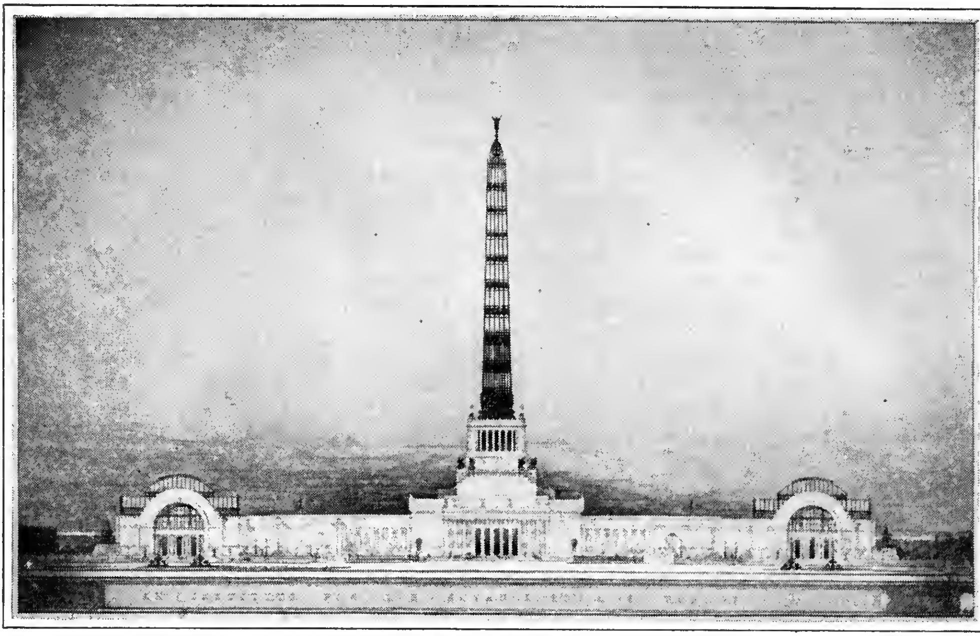
They'll take the driest serial
So long as it's aërial;
They'll take the saddest sentimental gush,
The ambient may squeak to them;
But if you dare speak to them
The only sound you'll get from them is, "Shush!"

In Nome or sweet Lafcadio
There's no escape from Radio!
Then, since you cannot dodge the atmosphere,
My songs shall cheer or trouble you
From station PKW,
Because, at least, I'd rather talk than hear!

EPILOGUE

(With the kind assistance of Mr. Longfellow)

I breathed a song into the air;
That little song of beauty rare
Is flying still, for all I know,
Around the world by Radio.



Courtesy *American Architect*

THE WINNING DESIGN FOR THE PARIS PRIZE

Of the Society of Beaux Arts. The problem set was the design of a transportation institute, devoted to the study of all means of transportation. The institute was to contain experimental laboratories, museums, and a hall for experiment with current inventions. The plan illustrated is the work of H. K. Beig, of the Armour Institute of Technology, Chicago. The feature of the plan is the great central mast which is designed for a radio station and a mooring mast for aircraft. Mr. Beig's application of a radio tower to a large building is an unusual piece of design

THE MARCH OF RADIO

By J. H. Morecroft

President, Institute of Radio Engineers

International Revision of Wavelengths is Necessary

WE HAVE just received a copy of a letter written by Alfred M. Caddell, Secretary of the American Radio Association, which is an illustration of the good work this organization is carrying on.

As we have repeatedly stated in these columns, the amount of spark interference encountered in the broadcast range is certainly more than is necessary. Dot and dash signals, with lots of power, come in on almost any kind of a set tuned-in on the lower wavelengths of the radiophone channel. And how unnecessary much of this traffic seems. The power used is frequently enough, it seems, to reach to Chicago even though the traffic is being carried on over a span of perhaps fifty miles.

The boats of the New England Steamship Company have frequently been the culprits in the matter. They sail from New York and a short distance up the New England coast, and

they surely seem to have lots to say over the radio channel. Naturally the authorities of the steamship company think that this traffic is important. In this case, it seems that their opinion cannot be considered very seriously in view of the hundreds of code-reading listeners who hear everything said by their ships. Many of these listeners know the code and the proper procedure for carrying on radio traffic perhaps better than their own operators.

The tone of Mr. Caddell's attitude toward the steamship company is well shown by the following paragraph from his letter.

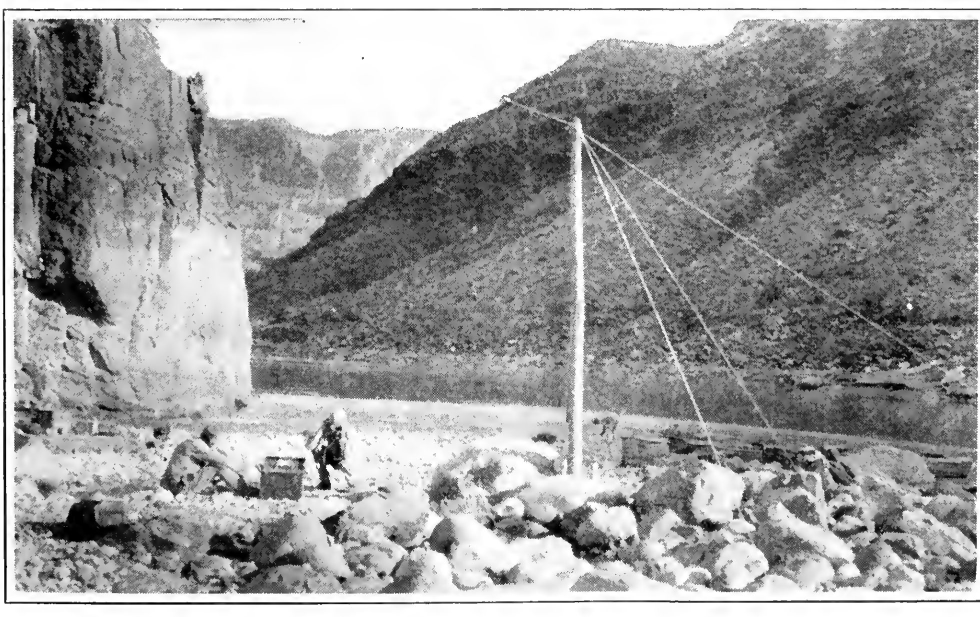
> Undoubtedly you know that there is a national regulation that specifies that all communication must be carried on with the least possible power, but qualified observers who have logged this Long Island Sound traffic, report that your operators use a considerable excess of power. And this, combined with the obsolete spark system employed results in a very coarse, poorly tuned signal that blankets the upper scale of the broadcast wavelengths and hashes up the finest programs.

In his answer to Mr. Caddell's letter, C. J. Pannill, General Manager of the Independent Wireless Telegraph Company, which controls the offending ships, disclaimed responsibility for the situation, stating that it was a question of wavelength assignment only, as the 600 meter (calling wavelength) and 706 meter (traffic wave) channels were too close to the broadcast channels so that it was impossible to carry on his traffic without the interference complained of. The letter made no comments regarding the alleged improper practices of his operators. Apparently the broadcast listener is not the only one who feels that the Radio Corporation is charging all the traffic will bear, as one sentence in Mr. Pannill's letter indicates—

> You ask that the company change the apparatus at present employed (spark) to tube transmitters, but this is not possible *owing to the prohibitive price asked for these transmitters.*

His letter, even though it did not promise any relief from the interference caused by the ship traffic, did bring up a question which will certainly bear investigation at this time, that is, the general matter of wavelength assignments. When the present allocation of wavelengths was made by international convention in 1912, radiophone did not exist to an extent worthy of attention, so naturally no consideration was given to the probable demands of the broadcast channels. Broadcasting was undreamed of then.

It is just possible that the marine radio traffic may well be carried out on a much longer wavelength than at present, as Mr. Pannill



RADIO IN THE GRAND CANYON

Of the Colorado. A recent exploring party of the United States Geological Survey brought with them a radio receiver. A 200-foot antenna, secured to one of the walls of the canyon, brought in signals from many broadcasting stations. Station KHJ, Los Angeles, broadcast them nightly news and weather reports

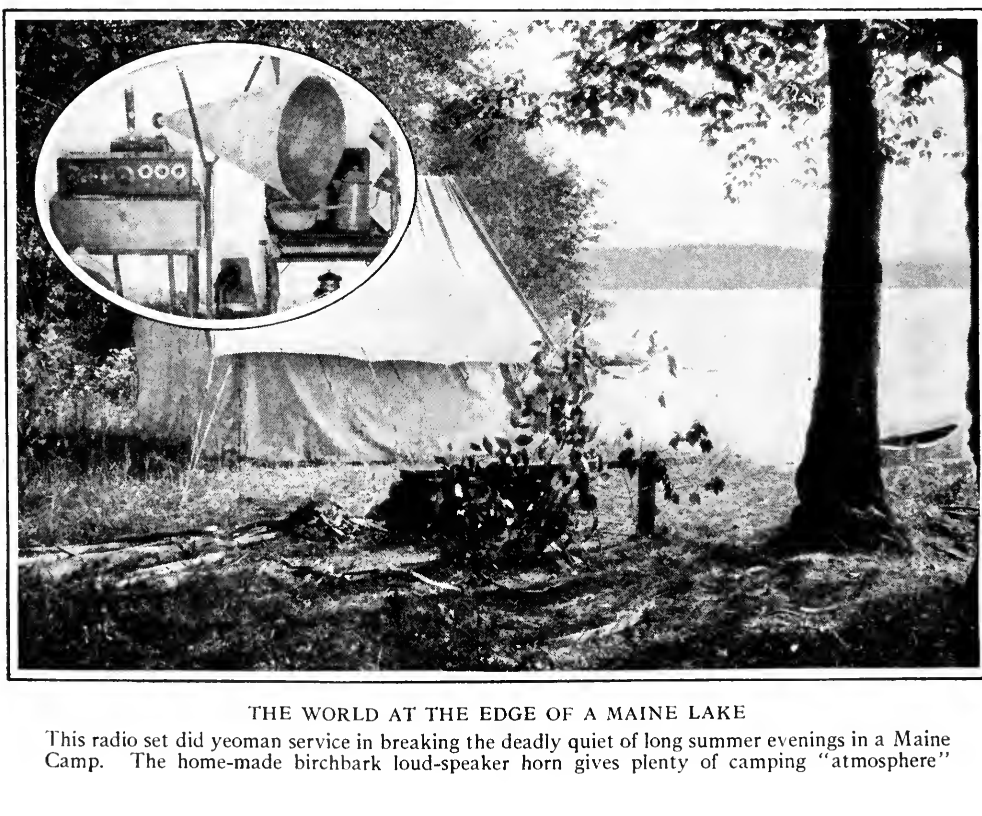
suggests, and it is also possible, in our opinion, that the naval service is monopolizing an altogether too wide a frequency band. In time of war, of course, the naval service should have any and all wavelengths it needs. In peace time there is no reason for shutting other services out of such a wide frequency band as is now done. A reasonable curtailing of the frequencies now set aside for the army and navy would not seriously interfere with the needs of these services. Certainly it would make available channels much needed for other purposes.

Real Romance In Radio Science

IN THE most recent list of "Standard wavelength stations" published by the Bureau of Standards, station WBZ, of Springfield, Mass., appears. This station has shown a maximum deviation from its assigned frequency of 890 kilocycles of zero per cent. since the Bureau began their measurements in May of this year. The physicists of the Bureau measure and record their readings to 0.1 per cent. and as WBZ is recorded as zero per cent., this means that the observed frequency was never as much as 0.05 per cent. away from its assigned value.

To a technically trained man, such a performance means much more than it does to the average broadcast listener, who has never had to make any accurate measurements. To illustrate what this precision means, let us suppose that we are ordered to cut off lengths of copper wire exactly one inch long. Could we do this as accurately as the radio station engineer maintains the specification for his frequency? And remember that measuring an inch with a rule, or whatever else we use, is apparently a much easier task than to measure the frequency in hundreds of thousands of cycles per second, of an electric current which cannot be either seen or held while the measurement is being made. And remember also that the current to be measured is generated in Springfield, Mass., while the measurer is stationed in Washington, hundreds of miles away.

What would it mean to be able to cut the piece of copper wire an inch long, an inch within 0.05 per cent.? Well, this would require that the wire would have to be an inch long to within one half of one thousandth of an inch. If your hair is light in color, one hair is about 0.003 inch in diameter, whereas if you are fortunate enough to have red hair it is as much



THE WORLD AT THE EDGE OF A MAINE LAKE

This radio set did yeoman service in breaking the deadly quiet of long summer evenings in a Maine Camp. The home-made birchbark loud-speaker horn gives plenty of camping "atmosphere"

OFFICERS OF THE RADIO MANUFACTURERS' ASSOCIATION

Recently organized in Chicago. The association was formed for the purpose of "improving and stabilizing the industry" and more than one hundred million dollars of capital is represented. H. H. Frost, President, is in the center, Frank Reichmann, Vice President, at the left, and A. J. Carter, Secretary, at the right

as 0.005 inch in diameter, so we can say that the piece of wire would have to be cut to the right length to within one tenth of the diameter of a red hair!

Pretty difficult to carry out, you will admit, yet this percentage of error allowed is the same as that within which the radio station keeps when the Bureau of Standards specifies that its frequency is as accurate as they find it for WBZ.

The engineers of the Western Electric Company talk nonchalantly of measuring the frequency of a radio station to within 0.01 per cent., and are actually making measurements to within 0.001 per cent. with only a small probable error! Sometime in the future a note on this remarkable achievement will be included in these columns, as this work surely is indicative of the March of Radio.

Pershing's Farewell Address

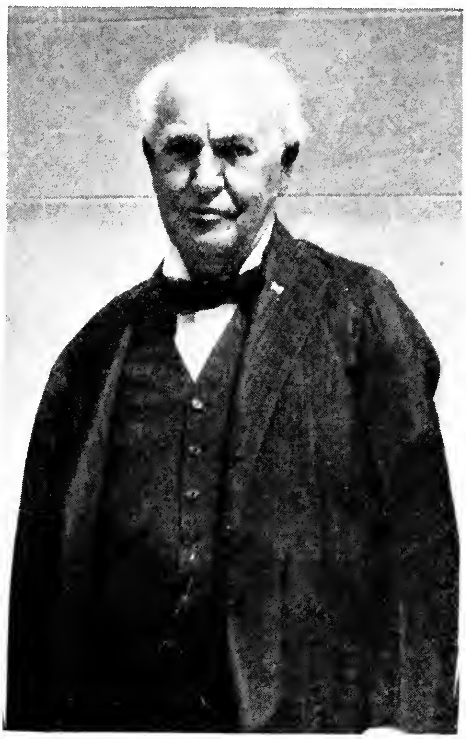
FEATS of broadcasting occur so often these days that their recording excites but passing interest. When broadcasting began, the charmed and thoroughly interested listeners were content to marvel at the mystery that allowed them to sit in the fastness of their own libraries and hear the voice of a distant singer or speaker. But now, and broadcasting is still young, the world's folk have accepted radio in the sense of broadcasting, and made it a part of their daily lives. If one were inclined to doubt that, a little more than casual glance at the daily newspaper would convince him how true this is. When cartoonists are using radio loud speakers and variously labelling them "Loud Politician," "Public Appeal," and the other tags so dear to the cartoonist, and newspaper humorists phrase their daily fun in radio terms, they are truly reflecting the thought of the times.

So when John J. Pershing, the retiring General of the United States Army, made his farewell speech on September 12th from eighteen broadcasting stations, fairly blanketing the nation with his voice, there were probably not many who listened who marvelled at the event. Stations from New York to California, and from Illinois to Texas were linked together by the wire lines of the Bell system to a microphone in the office of Secretary of War Weeks, where the ceremonies took place. There is probably not a town in the United States where the signals did not penetrate.

When Washington made his farewell to that handful of officers and men gathered at Rocky Point, New Jersey, in 1783, his voice was heard by that scattering few only. But now, the retiring General of our Army speaks to the Nation.

The linkage of these stations was a feature of the much-discussed National Defense Day and has furnished an excellent example of the service broadcasting may be to the Nation in time of national need. One wonders if the country would have been more deeply and perhaps quickly influenced in 1917, could they have heard Woodrow Wilson give his famous message to Congress, urging it to declare a state of war against Germany. It is certain, anyhow, that through radio broadcasting, the whole Nation can be linked to Washington, and brought into the very halls of government when necessity arrives.

We think it a bit unfortunate that the radio amateurs were not given an opportunity to show what they could do. The American Radio Relay League is now so well organized, and has so many expert member-stations,



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THOMAS EDISON

Inventor; East Orange, New Jersey

"There is not much in the radio being used for political campaigns this year. People like jazz music; they like to hear about contests such as the Democratic Convention, but to sit and hear a political speech—I'll tell you a story.

"A reformer went to Sing Sing to deliver a reform talk to the prisoners. He started in with that reform talk, you know, and kept up talking and talking until he had them all bored to death. He talked for an hour, and then some one—a colored man—let out a yell. A guard hit him over the head and knocked him senseless. When he came to in about an hour, the reformer was still talking. The man called the guard and said: 'Hit me again, boss, I can still hear it.'"

most of which are efficiently run and well equipped, that the organization should have been recognized in the same fashion as have the broadcasters.

Censorship in Radio Broadcasting

THE suggestion that the broadcasting stations of the Radio Corporation are censored, with all the sinister thoughts that such an idea arouses, soon drew an emphatic denial. The statement was made in one of the newspapers that "Officials of the Radio Corporation of America explained that it was their custom to require written copies of proposed radio addresses in advance of delivery, and to forbid any utterance that they considered unsuitable for transmission."

The next day, the President of the Corporation, General Harbord, wrote a letter to the paper in question stating that "it is not at all the policy of the RCA to censor the political speeches of the accredited political representatives in the coming elections." He further states that "when we have asked for an advance copy of a scheduled broadcast speech it has been when the subject was of a commercial nature, or other than political, and with one of the ends in view, either when it was desired to give advance publicity to the speech or when it was desirable to make certain that the speech was of a nature at once acceptable to the listening public."

Shall Prisoners Have Radio?

THE day has gone by when prisoners are hung up by the thumb or stretched on the rack periodically to convince them that the way of the law is best. We nowadays see to it that prisoners have light and fresh air—two of life's necessities without which any human being is soon transformed into a society-hating beast. Theoretically, any influence which will instill into the prisoner's mind the idea that law breaking doesn't pay, that the life of unharried freedom outside the prison walls is the only one worth while, should not only be allowed in the prison but should be incorporated as part of its regular régime.

What then about radio sets being allowed in prison cells? The contact with the outside world which radio makes possible for the prisoner cannot do him any harm, the social reformers say, and may do him some good.

A recent letter to us suggests that we express an opinion on the use of radio in prison. Having the normal amount of sympathy for the fellow who has been unfortunate enough to break the law and get caught (there are many law breakers who are not caught) one's natural reaction is to say, "Surely, let radio do its bit to make the prison life a little brighter." About the time we reached this conclusion, along came an announcement from the warden of the Pennsylvania State Penitentiary that a prisoner who had been allowed to have a radio set in his cell had been receiving code messages from one of his pals on the outside

as to how dope would be smuggled into the prison. The scheme, according to the story, had been working successfully.

All of which goes to show that one's sympathy may lead to an unjustified decision. So now we would say let the possession of a radio receiving set be allowed for "good conduct" to be immediately taken away for infringement of the prison rules. Such use of radio might prove quite an incentive to good behavior.

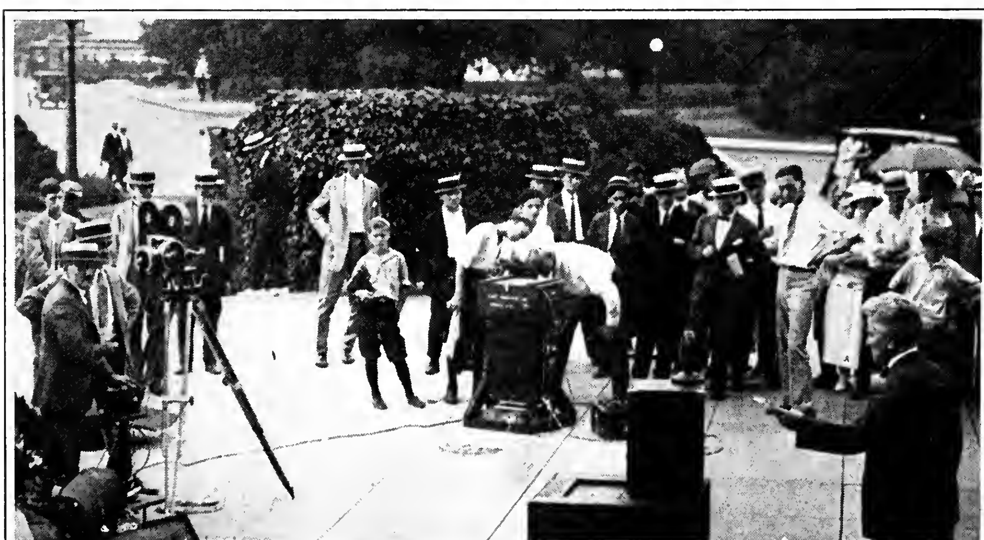
Telephoning to England

WE ARE always inclined to think of the United States as the one place on earth where things are planned and carried out on a tremendous scale. We have ranches in the West which have more space in one field than that in the largest farm in the little island across the sea; our buildings have fifty stories, our corporations have a capitalization of a billion dollars, we have more telephones in two of our cities than there are in four of the world's continents, and so on. Naturally we have thought of radio in America in larger terms than that of England and other nations. According to information of the Department of Commerce, we are surely to be outdone, in no uncertain way, in the size of radio stations. The English are putting up a station with an antenna a mile and a half long and half a mile wide, supported on twelve masts each 820 feet high! Each of these masts weighs 300 tons, and are being moved in sections so large that the transportation can be carried on only at night. With each mast an elevator is installed, large enough to take up four men.

It is understood that with this station the American Telephone and Telegraph Company expects to establish transatlantic radiophone communication. With the radio link established, the feat of telephoning from one's home to that of a friend in England will be an every day possibility.

Radio Invades the Apartment House

THE tendency to make the modern apartment house thoroughly up to date is well illustrated by the attempt on the part of the builders to incorporate radio reception as part of their service. In many apartment houses the antenna question is acute—and is becoming more so every day. One of our friends told us the other day that he had succeeded in discovering which of his fellow cliff dwellers persisted in using a blooper for a transmitter of unassigned and variable wavelength. Having been told by the oscillating set owner (after judicious questioning)



SENATOR ROBERT M. LA FOLLETTE

Independent Progressive nominee for President, rehearsing a speech for Dr. Lee De Forest's "talking movies." All of the Presidential candidates intend to use this device in the 1924 campaign. It should be possible to use this device for radio speeches, such as Senator La Follette gave on Labor Day

where the offending antenna was located on the roof of the apartment house our friend crept up in the quiet darkness of that evening and with a vigorous tug, dislodged the pole on which the howling receiver antenna was fastened. To his surprise he learned the next day that he had also pulled down seven others. Evidently such a situation, and there are many like it, bids fair to start a real intramural war.

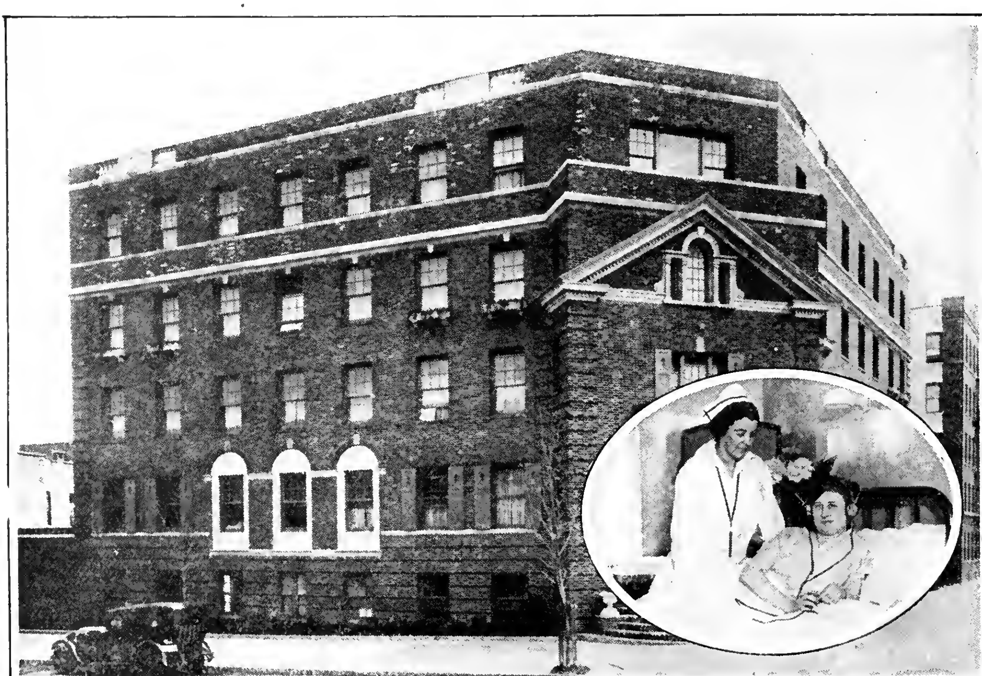
To avoid just such a situation, one apartment house has just been fitted with four antennas and receiving sets located in a "radio central" with an operator in charge. Each apartment has wires leading to the radio room and these can be plugged into any one of the four stations which the operator has tuned-in. It is necessary for the apartment house dweller to buy for himself an audio amplifier and loud speaker. This service will be appreciated by those who listen to complete programs. The real radio enthusiast we fear will have to buy a super-heterodyne, or a "knock-out" set of some sort, in addition to the apartment house set. Many are the listeners who still spend interesting hours in the absorbing chase of the DX signal. Maybe the stuff is no good when he gets it, but getting it—that's the thing that still fascinates.

Radio in the Modern Hospital

AT THE new Hunts Point Hospital, in the Bronx, New York each room is equipped with a radio plug. On the roof of the hospital, is the operator and the radio set. The audio output of the set can be received in each of the rooms by the use of head phones, which is the only feasible scheme of reception in a hospital where loud speakers are out of place.

The President of the hospital board, in commenting on the installation said:

> We have spent $500,000 in making this hospital the most modern institution of its kind in the Bronx. Its equipment, from the operating room down through the entire plant, is the most modern and scientifically perfect obtainable. But I do not believe that there is a single modern feature that can compare in its ultimate effects for good on the patient with the radio installation.



HUNTS POINT HOSPITAL

New York, which is completely equipped with radio. A central receiving set whose output, greatly amplified, furnishes broadcast programs to each bed, through individual head phones. The hospital officials expect the radio to do much to break the tedium of the weary and often lonely hours of convalescence

Interesting Things Interesting People Say

SIR ROBERT DONALD (London; former editor, *The Daily Chronicle*, speaking before the London Rotary Club): "In 1913, I predicted that the chief competitor of the newspaper would be new developments in the dissemination of news. What I did not foresee was the development of broadcasting. In the future, I think that broadcasting will become the chief competitor of the newspaper. News that can be broadcast is limited in many ways, for broadcasting can give the facts and no description, which is an advantage, because many newspapers give a description and no facts. However, if people who hear speeches over the radio do not find them reported to a sufficient extent in the newspapers, they may be disposed to ask the reason why. This will stimulate the newspaper."

FRANK E. SEAVY (Somerville, Massachusetts; Department of English, Tufts College, in a letter to WGY): "When I think of the thousands of homes into which you are sending excellent music daily, homes in which, three years ago, no music above street songs was known, I feel that your work in education is vastly more important than ours."

CAPTAIN H. J. ROUND (London; Engineer, British Marconi Company, in the London *Morning Post*, regarding the use of loud speakers): "The engineer (in developing loud speakers) has to be satisfied if he can retain intelligibility in all cases with not too great a divergence from the human quality. . . . One cannot forecast the feelings of the electorate if politics becomes merely a matter of noise."

F. C. MORTIMER (New York; "Topics of the Times" in the New York *Times*): "It has been noted as a curious fact that several minutes before more than a small part of the enormous crowd gathered at Epsom Downs knew the name of the Derby winner, it had become old news to many people in such far away lands as India, South Africa, and South America. That, of course, was another of radio's many miracles, for it took only a fraction of a second for the mysterious vibrations to reach the other side of the world. . . . Anybody could survive waiting a few minutes for the winner's name, and the episode may be taken as illustrating anew that fact that, in respect to most of the material broadcast by the new device, chief interest lies in its manner of transmission."

EDWARD S. VAN ZILE (New York; in the New York *Times Book Review*): "If more books are being distributed in this country than ever before, it follows that the outstanding new features in our social and family life, namely, the motor car, the movie, and the radio are exerting not a centrifugal, but a centripetal force on the library. . . . The fact is . . . that the radio has tended toward the integration rather than the disintegration of the family. . . . The average American family is more united in its hours of leisure than ever before. . . . The cosmopolitan impetus to the mind vouchsafed by the radio inevitably intensifies the interest of the average American household in the enlightenment to be got from books. . . . Why, then, despair about the Republic?"

WILL ROGERS

Humorist and Rope-Twisting Monologist

"If you have a radio, now is a good time to get it out of fix. All you will hear from now on until the 4th of November will be: 'We must get our government out of the hands of Predatory Wealth.' 'The good people of this Great Country are burdened to death with Taxes; now what I intend to do, is. . . .' What he intends to do is try and get elected. That's all any of them intend to do. Another one that will hum over the old static every night will be: 'This country has reached a Crisis in its National Existence. Can we afford to stand aloof from our worldly obligations? . . . Of the defeated candidates, I am the only one that had the nerve to remain in New York.'"

CAPTAIN ECKERSELY (London; Chief Engineer, British Broadcasting Company): "The present receptive range of the average crystal set is approximately twenty-five miles. My belief is that by transmitting from a sufficiently powerful station, this range can be increased to one hundred miles at least."

How to Build a Six-Tube Second-Harmonic Super-Heterodyne

Whose B-Battery Consumption is Exceptionally Low—A Set for the Constructor Interested in Efficiency and Economy

By ALLAN T. HANSCOM

FOR some time we have been looking for a super-heterodyne which required fewer tubes and was more economical to operate than those we have described heretofore. Mr. Hanscom brought one of his six-tube receivers to our laboratory and demonstrated its superiority to our entire satisfaction. It is easy to tune, selective, sensitive, and produces exceptional volume with clarity far above the ordinary.

This receiver, because it is necessary to make rather than purchase some of the coils, is somewhat more difficult to construct than those standardized receivers we have previously described. Receivers of this type are going to improve beyond our powers of imagination and this improvement is indicated very clearly in Mr. Hanscom's work, which we feel is a long step in the right direction.—THE EDITOR.

THE purpose of this article is to outline the theory of operation and to describe in detail the construction of a receiver that can be built successfully by the fans who like to make their own sets.

There are several types of super-heterodynes available, and in most cases the results are accomplished by using eight tubes or more, with corresponding large drain on A and B batteries. This is the factor that has caused the super-heterodyne to be called the "Rolls-Royce." The receiver performs excellently but at exceedingly high first cost and high maintenance.

The super-heterodyne designed by the writer is not an expensive set to build, it is not a freak, and it will bring in all stations that any good set will with a B-battery consumption of less than fifteen milliamperes using 201-A tubes and an eighteen-inch loop. When we consider that commercial types of five-tube neutrodynes draw about twenty milliamperes from the B battery, it is apparent that this super-heterodyne is not an expensive set to maintain.

The biggest advantage that a super-heterodyne has is its ability to operate on a loop. A good set of this type will positively get down to the sound level of the atmospheric electrical disturbances when using a loop, and it is therefore of no advantage to use an outdoor antenna. A poor super-heterodyne, with a low factor of amplification, will work better on an antenna, but so will any type of set, for that matter.

WHAT A SUPER WILL DO

WHAT you will hear with a super-heterodyne is exactly what you will hear with any good set, except that the directional effect of the loop will prevent some interference and the ease of tuning makes the stations easier to obtain. A super-heterodyne will not amplify a signal if the signal isn't there. By that I mean that a broadcasting station a thousand miles away cannot be heard unless the carrier wave is stronger than the static disturbances *when it reaches the receiving set.* But for the ability to go out and get a lot of stations quickly and easily when conditions are right, the super-heterodyne can't be surpassed.

Radiation, sometimes incorrectly called "re-radiation" is a fault of many super-heterodynes. In general, any circuit which has an oscillating vacuum tube coupled to a loop becomes a miniature transmitter. This condition is greatly aggravated by the use of

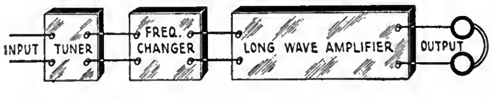


FIG. 1

a large antenna. The super-heterodyne described herein does not radiate because the oscillator isn't coupled to the loop. In addition, the oscillator frequency is nowhere near the frequency of the received signal, because the principle of the "second harmonic" is used.

ADVANTAGES OF THIS SUPER

AT THIS point it may be well to consider the essential parts of the super-heterodyne as shown by Fig. 1.

The only reason for this type of set is the fact that it is better to amplify on the long waves than at the usual broadcasting frequencies. Assuming a 300-meter wavelength which has a frequency of 1,000,000 cycles per second, the super-heterodyne changes this frequency to the exact value that will pass through the long-wave amplifier (see Fig. 1). The frequency of this long-wave amplifier is not variable, and because it is in the neighborhood of 40,000 cycles per second, the amplification per stage is very high. Because the amplifier is designed to pass only a narrow band of frequencies, the selectivity is also high.

The manner of creating this new low frequency is a puzzle to many people, but it is accomplished by a combination of the signal frequency with a new frequency which is generated within the set. Arithmetically, the case is as follows: Assuming the incoming carrier wave with a frequency of 1,000,000 cycles, if we generate a frequency in the set of 1,040,000 cycles, the difference between the two will be 40,000 cycles. If the generated frequency is 960,000 cycles, the difference between that and 1,000,000 cycles is still 40,000. Because the two frequencies are combined, the resultant frequency is the difference between the two. There is also a frequency equal to the sum of the two, but this is not utilized.

PRINCIPLE OF THE SECOND HARMONIC

ANY frequency has certain harmonics. By this we mean that a frequency double or triple the original will bear a certain fixed relation to it at all times. If we assume the case of a man and a small boy walking up the street together, the man may be taking strides of exactly thirty inches. Now, if the boy is taking two steps to the man's one, and the boy's steps are exactly fifteen inches, then they

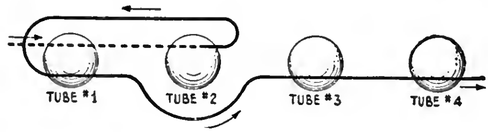


FIG. 2

will always be in line. In this case the man's step is the second harmonic of the boy's step.

In applying this principle to the super-heterdyne, the arithmetic gives us this:

Incoming signal . . .	1,000,000 cycles
Second harmonic of this .	500,000 "
Generated frequency . .	480,000 "
The difference	20,000 "

But 20,000 cycles is the second harmonic of 40,000 cycles, which is the frequency of the long-wave amplifier. By this method we generate a frequency in the set which is so different from the signal frequency that for practical purposes it is entirely independent of it.

It must be understood that the amplifier frequency does not have to be exactly 40,000 cycles. The lower this value is, the closer it approaches the audible frequencies, which extend up to about 12,000, while as it goes higher, the problem of amplification becomes more difficult.

Fig. 2 shows the path of the signal through the first four tubes. The dotted lines represent the frequency of the received signal, the solid line shows the amplifier frequency.

The incoming signal is amplified at radio

THE FRONT OF THE PANEL
Extreme simplicity of control is a notable feature of this receiver

frequency by tube No. 1, and passed into tube No. 2. This tube is oscillating and generating a frequency which combines with that of the incoming signal to produce a new low frequency which is fed back into tube No. 1 and amplified. This is known as reflexing. From No. 1 the output now goes to No. 3, where it is again amplified and then detected by tube No. 4.

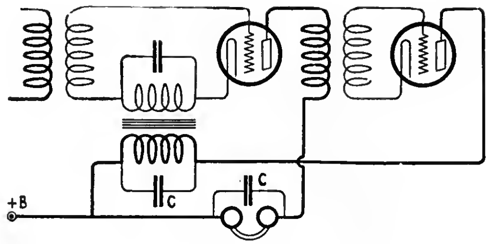


FIG. 3

ABOUT REFLEXING

WHAT are known as reflex receivers are those in which the audio frequencies are fed back through the tubes which are already amplifying radio frequencies. In this type of super-heterodyne, the audio frequencies are not reflexed, but the same conditions apply.

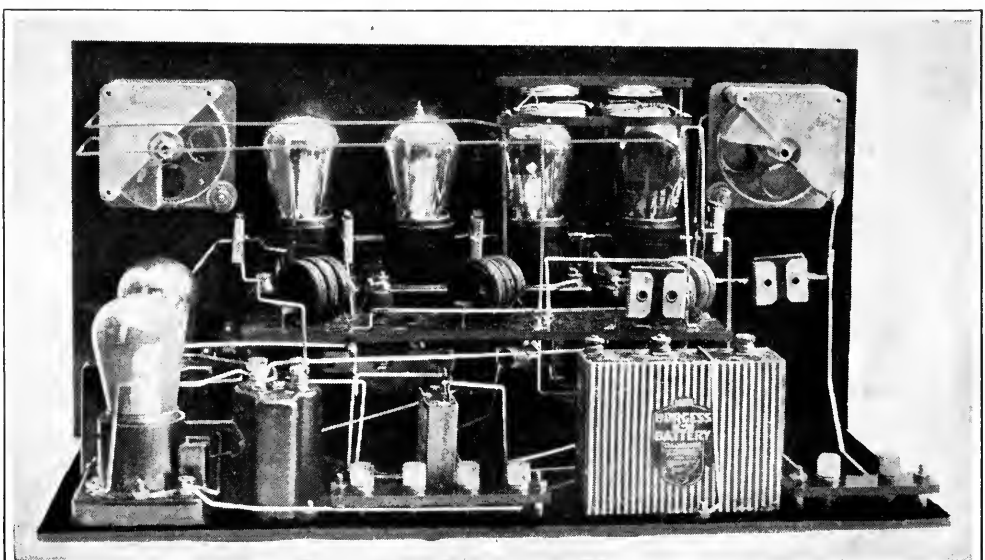
It is obvious that a tube may be reflexed for both radio and audio frequencies, but the intermediate frequency which is utilized in the super-heterodyne must necessarily be above audibility.

Fig. 3 represents a typical reflexing arrangement where the fixed condensers are used to bypass the radio frequencies. Most people do not realize that the shortest path for radio frequencies is the best path. This is shown in Fig. 4, which is exactly the same as Fig. 3 except that the radio frequencies are bypassed directly back to the filament.

As will be seen in the circuit diagram, the first tube acts as a radio-frequency amplifier while the second tube is an oscillator and detector. The output of the second tube consists of three frequencies: first, the frequency of the incoming signal; second, the frequency of the oscillator; and third, the beat frequency, which is the difference between the other two.

The higher frequencies are bypassed back to the filament of the oscillator tube but the beat frequency is fed into the primary of the first intermediate-frequency transformer. The secondary of this transformer is connected in the manner indicated by Fig. 5 which is done in order to neutralize the tube capacity which is accomplished by means of the neutralizing condenser N.

The coils A, Fig. 5, are the secondary of an intermediate-frequency transformer. If they are equal and the condensers C are equal, then the tube is neutralized, provided the condenser N is equal to the grid-plate capacity



REAR VIEW
Of the receiver, showing the method of mounting the fixed condensers between the tube sockets

of the tube. The high-frequency voltage from the loop cannot pass a current through the coil A, because of its high impedance, and the low-frequency voltage generated in A cannot pass a current through the loop because of the condenser C in series with the loop. And because the first tube is neutralized, it cannot oscillate and no potentiometer is required.

AIR-CORE TRANSFORMERS

MANY super-heterodynes use transformers with iron cores, and in most cases they use one sharply tuned transformer or filter to make the intermediate frequency sharp enough for good selectivity. The disadvantage is that the iron-core transformers are not as efficient, but the difficulty with the air-core transformers has been that the tuning is apt to be too sharp. This has been overcome in the set pictured by a special design of coils with a provision for moving the coils to tune each stage for the most efficient amplification. By this means great selectivity is obtained as well as great amplification with an absence of the hissing sound which is so prevalent in some super-heterodynes.

As might be expected, the tuning of the set is very sharp. A 500-watt station ten miles away can be completely tuned out in less than one point on the oscillator scale. The dial readings are always the same for the same station, and with the proper number of turns in the loop the settings of both condensers are approximately the same for any particular wavelength.

HOW TO BUILD THE SET

WITH the foregoing explanations, the circuit diagram, Fig. 6, may be easily understood. It is not essential that the apparatus be mounted as closely as shown in the photographs, but it is absolutely necessary to keep all grid and plate leads as short as possible and remember that the fixed condensers are bypassing objectionable radio frequencies *back to the tube where they come from. Keep these condenser wires short and direct.*

The materials needed are as follows:

1 Panel 9″ x 18″ x $\frac{3}{16}$″ (Don't use wood)
1 Panel 8″ x 18″ x $\frac{3}{16}$″ (Don't use wood)
1 Panel 4″ x 10″ x $\frac{3}{16}$″
3 Hard rubber strips—$\frac{1}{4}$″ wide, $\frac{3}{16}$″ thick, 2″ long
5 Hard rubber strips—1″ wide, $\frac{3}{16}$″ thick
  3 4″ long (2 for oscillator, 1 for terminals)
  2 3″ long (1 for oscillator, 1 for loop terminals)
6 Sockets—Composition, not metal
2 Jacks—1 double circuit, 1 single circuit
2 Rheostats—1 6 ohms, 1 30 ohms, any good make
2 Variable condensers—.0005 mfd.—Any good make with vernier dials or knobs (not separate vernier plates)
7 Fixed Condensers—2 .0005 mfd. 2 .00025 mfd. 3 .002 mfd.
1 Grid leak and condenser combined, .00025 mfd. and from 2 to 5 megohms.
2 Audio-frequency transformers—(low ratio)
6 Binding posts
  Square tinned bus bar, $\frac{6}{32}$ screws and nuts, etc.
9 Coils for intermediate-frequency transformers
4 Coils for oscillator
1 Dubilier Duratran radio-frequency transformer
1 Neutralizing condenser
1 Bypass condenser, 1 mfd.

The first step in the construction of the set is the assembly of four sockets on the 4″ x 10″ rubber panel as indicated in Fig. 7. After mounting the sockets the $-F$ connections are joined with bus bar and the $+F$ connections of tubes 1, 2, and 4 counting from the left are joined. This is shown in the photograph of the top view of the set.

The next consideration is the intermediate-frequency transformers. Each transformer is made of three small honeycomb coils which are clamped on the rubber panel by strips of hard rubber and small screws. The center coil is the primary and the two outside coils form the secondary. The coils are mounted at an angle of 55 degrees as indicated in Fig. 7 with a space of about $\frac{1}{16}$″ between adjacent coils. By loosening the screws which hold the small hard rubber strips, the coils may be moved endwise for accurate tuning after the set is finished.

It is very important that the wires from the coils be connected in the right direction. The inner ends of the two outside coils are connected and the coils are mounted so that the outer ends of these two coils face

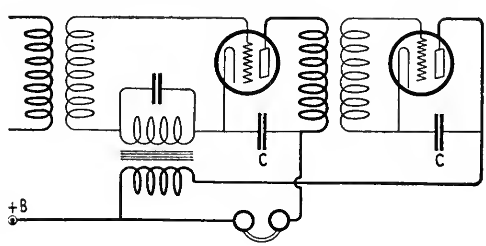


FIG. 4

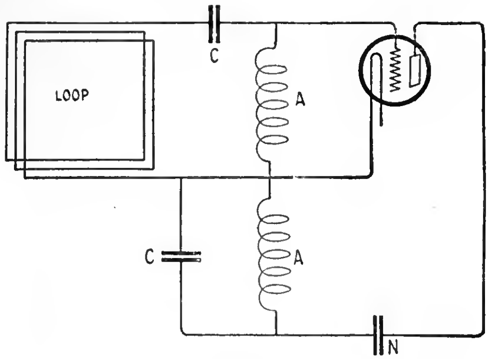


FIG. 5

in opposite directions. Looking at the end of the coils, if the wire runs clockwise starting at the outside of the first coil, it must continue to run clockwise starting at the inner end of the coil in series with it. See Fig. 8. The center coil, which is the primary, may be mounted either way.

After this, the Dubilier transformer is mounted midway between sockets 1 and 2 on the *under side* of the panel with the −F and +B connections at the rear. Then the grid leak is mounted on the under side of the panel near the grid connection of socket No. 4. At this point it is optional whether the mounted parts are wired or the wiring left until the socket assembly is fastened to the front panel.

The photographs clearly show the arrangement of parts on the front panel (9″ x 18″) and the base panel (8″ x 18″). Owing to the different parts which may be used, it is not possible to give absolute dimensions. Looking at the front view of the set, the left-hand dial tunes the loop and the right-hand dial tunes the oscillator. The left-hand lower knob is the rheostat which controls all the tubes and the right-hand lower knob is the 30-ohm rheostat which controls the filament of the third tube for the regulation of the volume. It is suggested that the audio stages be wired before the base panel is joined to the front panel, although this is not absolutely necessary.

The bus bar may be rigidly secured to the sub panel by boring a small hole and bending it as in Fig. 8A.

In soldering, use only resin-core solder.

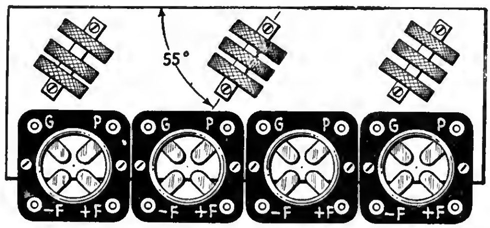


FIG. 7

If panel-mount sockets are used, it is possible to fasten the four-tube assembly to the front panel of the set by using the socket mountings, otherwise use brass angle irons. In fastening the front panel to the base panel, it is possible to drill the edge of the base panel and tap for $\frac{4}{36}$ machine screws, but this may also be avoided by using brass angle irons.

The variable condensers should be connected

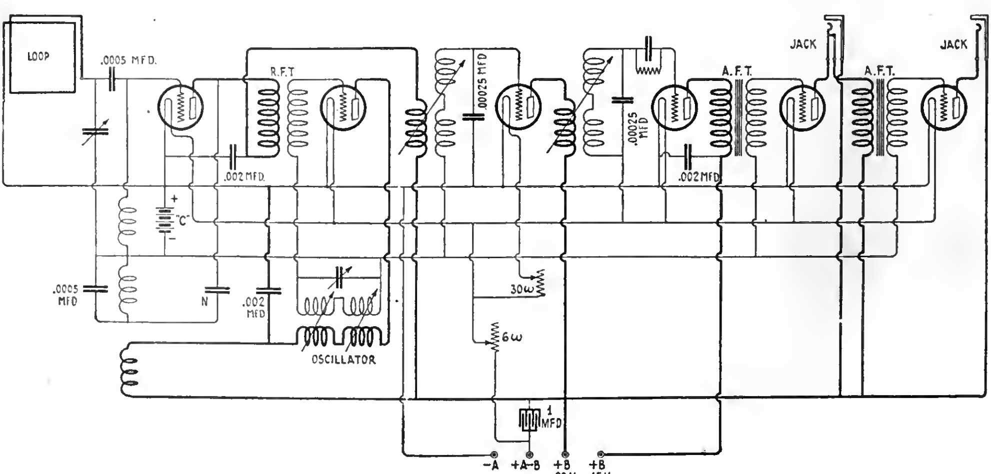


FIG. 6
Complete diagram of the six-tube super-heterodyne

so that the fixed plates go to the grids of the tubes and the movable plates are connected to the C-battery negative.

To avoid errors, it is an excellent plan to draw over the wiring diagram with a colored pencil as each wire is connected.

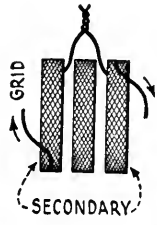


FIG. 8

The C battery is fastened to the base panel with a piece of bus bar as shown in the photographs.

NEUTRALIZING THE FIRST TUBE

IT WILL be seen from the photographs that the coils in the first intermediate transformer are not evenly spaced. This is because with a fixed value of neutralizing condenser the neutralizing can best be done by moving the coil A in Fig. 9. The value of the neutralizing condenser is about equal to the

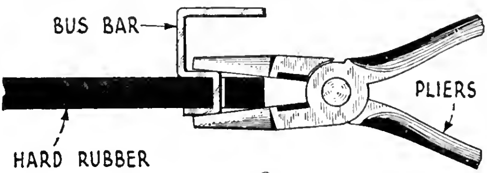
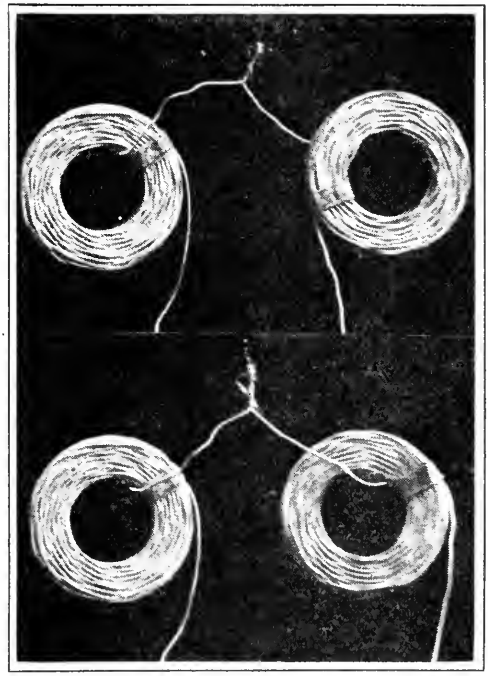


FIG. 8A

full capacity of a neutrodyne condenser when the rod is connected to one terminal and the sleeve to the other. See Fig. 10.

A flexible wire connection may be made to the metal tubing to allow further variation. Once set the position of the metal tubing may be fixed with a drop of wax.

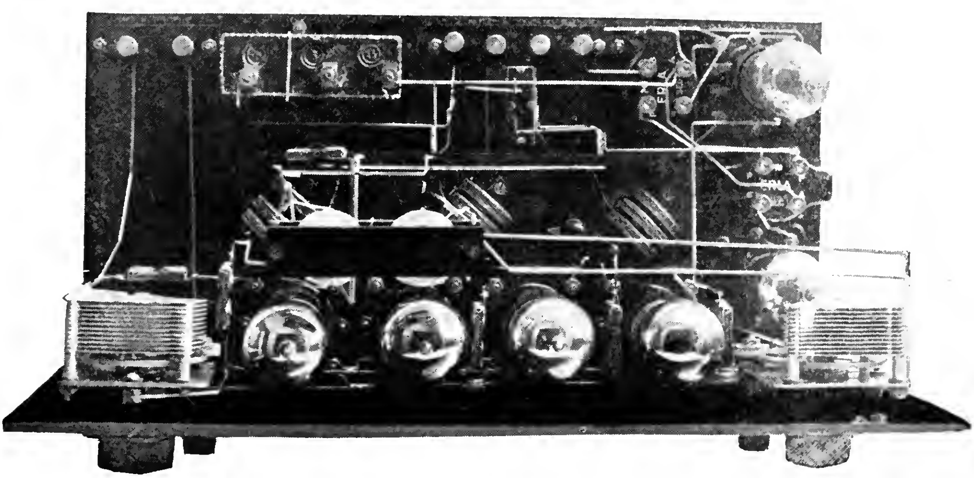


HOW TO MOUNT THE OSCILLATOR COILS

The wrong way is shown at the top of the photograph and the correct way at the lower part of the cut. Both windings should be placed so the wires run in a similar direction

THE OSCILLATOR

THE oscillator is composed of four coils, two in series in the grid circuit and two smaller coils in series in the plate circuit. The manner of connecting these coils is very



TOP VIEW OF THE RECEIVER

Which shows quite clearly the mounting and position of the intermediate transformer and oscillator coils

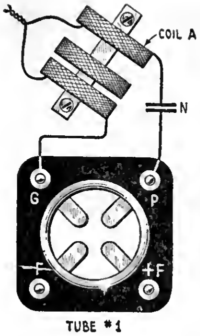


FIG. 9

important, and is indicated in the photographs. They are connected so that the direction of the current if clockwise in one coil will be counter-clockwise in the coil in series with it. This is done to provide a closed magnetic field as indicated in Fig. 11.

To make the tube oscillate it is also necessary to place the grid and plate coils together so that the *direction* of *rotation* of the grid wire is opposite to that of the plate wire in the other pair of coils. See Fig. 11.

The manner of mounting the oscillator is clearly shown in the photographs. It is supported by the bus wire leads which are fastened to each corner of the lower rubber strip. The intensity of the oscillations can be varied by changing the thickness of the spacer between the pairs of coils. For best results this should be about $\frac{3}{16}''$.

OPERATING THE SET

AFTER the set is completed and the tubes are in place, connect the A battery and light the tubes. If they light, then turn them off and connect the − B battery to the + A binding post. Then touch the +B wire to the +B binding post. This may spark the first time it is touched because of the capacity of the bypass condenser, but it should not do so more than once. Then the +B 45 may be connected and the set is ready for adjusting. Turn the volume control rheostat full on and then light the tubes to normal. With phones plugged in the last jack, it ought to be possible to tune-in a powerful station after connecting the loop. Oscillation in the first tube may be noted by a series of bird-like whistles as the dials are turned. This may be stopped by moving the coil A, Fig. 9, to the proper point, or by varying the neutralizing condenser. If the set is wired properly, this adjustment is not very critical.

CAUSES OF FAILURE TO OPERATE

AMONG the various causes of trouble in operation of this receiver, some of those most apt to be encountered are:

1—Wrong wiring
2—Faulty tubes
3—Short-circuited fixed condenser
4—Wrong polarity on C battery.

It will be found that a station can be tuned-in at several places on the oscillator dial, but it is usually heard best at a setting about the same as the setting of the loop-tuning dial, provided the loop is of a value that will bring a 360-meter station at about 35 on the condenser scale.

THE LOOP

WITH the various loops now on the market, it is easier to buy one ready made than to make one, although a suitable loop can be made of single lamp cord (stranded) of 13 or 14 turns on a frame 18 inches square, with the turns spaced from $\frac{1}{4}$ to $\frac{3}{8}''$ apart.

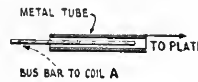


FIG. 10

Don't use fine wire and green wood. The larger the loop, the fewer the turns for a given wave-length and the greater the signal strength. The writer has used a variometer for a loop on stations 200 miles away with enough intensity to operate a loud speaker, but don't penalize the set with a poor loop. Get a loud signal and then control it with the rheostats.

A HINT TO HOME CONSTRUCTORS

DON'T solder lugs on the end of bus bar when it is going to be connected to terminals on sockets or transformers. It is far better to invest in a pair of round-nosed pliers and bend an eye on the end of the bus bar. Don't screw down the terminals with your fingers, because they will not stay tight. Use pliers or a wrench.

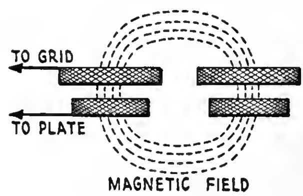


FIG. 11

A TEST PERFORMANCE

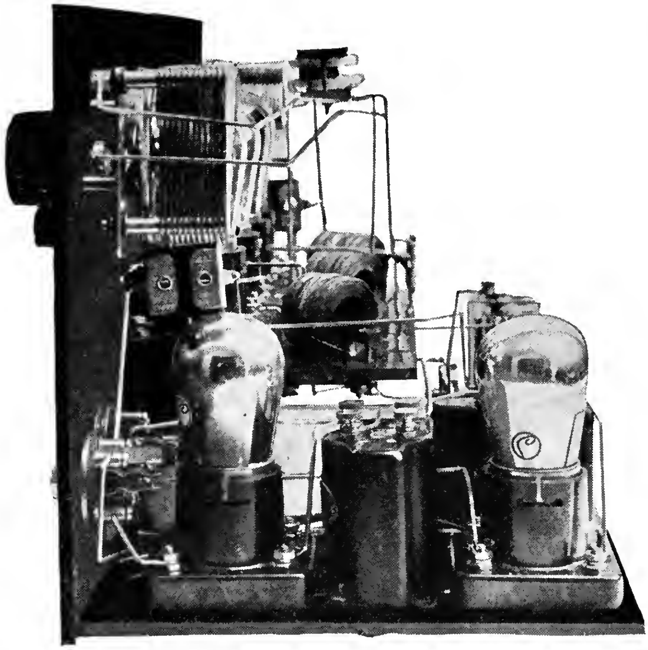
IN OUR laboratory in Garden City we were able to bring in Philadelphia and Schenectady in daylight with good loud speaker volume, using this set and a small loop and *five* tubes in *daylight*.

During two tests made at night, each of two hours duration, using five tubes and a loud speaker, the following stations were logged. The dial settings were as indicated, and may be generally helpful to those who duplicate the receiver just described. Some idea of the

selectivity of this receiver may be had by noting the number of stations logged between WEAF and WJZ, both of which are less than twenty miles from Garden City. Both were operating most of the time during which the four distant stations were logged.

LIST OF STATIONS HEARD

CALL	DIAL SETTINGS LOOP	DIAL SETTINGS OSCILLATOR	WAVE LENGTH
WNYC	78	83	526
WIP	75	81	509
WEAF	66	73	492
WHAA	65	88	484
WOC	64	71	484
WDAF	63	69	411
WCAP	59	66	469
WJZ	55	62	455
WSB	51	52	429
WLW	48	64	309
CFCA	48	54	400
WTAM	41	65	390
WGY	39	50	380
WMAF	38	42	360
WEBH	37	42	370
WJAR	33	37	360
WLS	32	35	345
WHN	32	38	360
WCBD	32	36	345
WBZ	30	34	337
KDKA	28	32	326
WTAS	22	26	286



SIDE VIEW
Showing the output end of the set

Many stations not included in this list were heard but were not logged because call letters were not heard. It is to be noted that most of the stations on this list are not local.

This particular receiver we used is not a freak. We have tried two, and Mr. Hanscom has made several others. They all have the same characteristics.

We were so favorably impressed with this new departure in storage battery tube outfits that we contemplate using one at the temporary receiving station we are going to equip somewhere on the coast of Long Island for our International broadcasting tests. Another receiver of this type will be used by Mr. Hanscom at his home in Woonsocket, Rhode Island, for the same purpose, and he will arrange to report reception directly to our Garden City Laboratory.—THE EDITOR.

The Listeners' Point of View
Conducted by Jennie Irene Mix

Is Radio Standardizing the American Mind?

THE discussion that has of late been carried on in this department, regarding the relative adaptability of the masculine and feminine voice to radio broadcasting, is still calling forth opinions from many of our readers. These opinions are often supplemented by others having to do with various different features of broadcasting. This goes to prove that some radio listeners are doing their own thinking, and are not, as President Faunce of Brown University recently said, becoming possessed of the "mob mind."

This "mob mind," according to President Faunce, is being created by the radio because, day after day and night after night, hundreds of thousands and at times millions of people listen to the same speeches, music, drama, stories—all of these features brought down to the level of mass intelligence. This is rapidly creating, in his opinion, a standardized taste along educational and amusement lines. A standardized mass taste means mediocrity. This is not a direct quotation of his statements, but is the gist of their meaning.

ETHEL MILLER

Mezzo soprano. Miss Miller was soloist at one of the series of concerts given by the Kudisch Ensemble from station WJZ, New York. The programs by this ensemble have proved one of the most successful among the musical features introduced at this station

If the radio were never to rise above the level of its present daily achievements, all that President Faunce has said would be true. But there are many indications that, as soon as owners of radio sets lose the desire to listen-in simply for the novelty of the thing, a portion of the public will demand something better than the sort of education or entertainment that appeals to the mob mind. And as soon as they make this demand it will be granted. The fact that such people are among the listeners-in, proves that ultimately the radio will not standardize the American mind. It may seem to be doing so now. Indeed, President Faunce can find much to support his opinion. But he very likely is not closely in touch with the inner workings of this new and great medium of enjoyment. If he were, he would realize that a goodly number, instead of swallowing all that they hear, whole and without thought, are listening with discrimination, and voicing whatever objections they feel in no uncertain terms.

Radio music, justifiably, comes in for the largest amount of such criticisms, and next

—Trinity Court Studio, Pittsburgh

ETHEL WHITTLESEY

As she appeared when featured in a costume recital of old time songs at station KDKA

to music come the speeches. It is not the quality of the speeches that brings forth this criticism, but rather the manner of their delivery. The large majority of radio speeches are, of course, read from manuscript, which is as it should be, for reasons too obvious to mention. But why should they *sound* as if they were read? As you listen, you can fairly see the speaker's eyes fixed on his manuscript. The effect is even worse than when a speaker in a public auditorium reads an address without the manuscript being in evidence instead of delivering it. If a man once read a public address in the monotonous tone employed by radio speakers he would never get an engagement twice in the same town.

Radio Speeches Are Too Much a Colorless Monotone

ANYTHING even approaching oratory is obnoxious over the radio. Familiarity is worse. But why a colorless monotone? Many speeches original in construction which contain ideas well worth the hearing, sound for all the world as if they were being read verbatim out of an encyclopedia. An announcement of tremendous import broadcast would sound like a platitude if given in a pedantic tone. The spoken message by radio can never rise above the quality of the speaker's voice and diction.

As for the diction of most radio speakers, it is well to let one who has frequently broadcast, and who has given much thought to this subject, express his opinion. This opinion was received by the present writer in a letter commenting on various matters discussed in this department. The writer of the letter is Richard K. Morton of South Boston, Mass., who has broadcast speeches from stations WBZ, WJAR, WGI, and WEAN, his subjects including historical and scientific themes, citizenship, humor, and biographical sketches. He has also conducted musical programs at a number of broadcast stations. So, taken altogether, he knows whereof he speaks when he expresses an opinion on radio talks. He writes:

HELEN KLOUGH

Motion picture correspondent and screen star, has been heard with distinct success through station WOR, Newark, N. J. One of Miss Klough's most popular talks is on "How I Interview Famous Stars, and What they Say"

I believe that the radio is showing us how few speakers have really good voices and delivery. It is showing the effect of a decline in forensic art, in practice of reading aloud, and, above all, in careful articulation and enunciation. We are lip-lazy, and we clip our syllables and sounds. We do not have a pleasant variation in tone quality. We mumble down our shirt fronts. We do not know when to breathe while speaking. We affect a sanctified monotone or an excited staccato, in our delivery. Any listener-in can add faults to this necessarily brief list. There are few listeners-in who do not fervently await better radio phonetics.

All who do their own thinking, and there are a goodly number of them in radio audiences, will hail with joy the day when the faults just quoted are eliminated from broadcast speeches. But the shortcomings in this feature of radio are not wholly due to the speakers, according to Mr. Morton. Note what he has to say about studio management.

What can the radio station do in this matter? It can test voices before putting them on the air. A sign, "Careful Enunciation," would be more valuable to a studio than the injunction, "Quiet." Fit power of the transmitter to the locality. Place the microphone better. Prevent stuffy atmosphere in the studio. Do not permit many to be close by a speaker while he is on the air. Remove from speeches difficult words and phrases, ambiguities, poor transitions, and current banalities. Prohibit too many freak broadcasts, and cheap humor. The best radio stations demand an advance copy of all proposed talks, but, from experience, I know that they should also have a guarantee as to the nature of the voice which they propose to put on the air. . . . Through good radio phonetics, public interest will be maintained in worthwhile radio speeches. The radio will then have a better chance to serve the community.

To all of which many of our readers will no doubt give their unqualified approval.

Some of the Worst and Some of the Best

AS FOR radio nuisances, we desire again to go on record with the statement that the worst of them all is the announcer with that nice, chummy, familiar manner, who takes you into his confidence. Who tells you that if

you will stand by for a moment he is going to give you, oh, something just too sweet, or lovely, or funny for anything. Who says, "Well, here we are again, feeling fine. How're you?" Who tells you, "Say, this man is going to sing the latest love song about a sweet young thing, and he's been married twenty years! Hope wifey isn't listening-in." Who signs off with, "Good night. Sleep tight. . . . Turn off the switch, George."

Time cures many evils, and time will cure this one. The instant you hear an announcer at a station you know what class of station it is, and in what sort of town it is located.

Of late, this department has been receiving numerous comments, all laudatory, anent the announcing of "Uncle John," of KHJ, the station conducted by the Los Angeles *Times*. Uncle John, whose full name is John S. Daggett, bids fair to rival the climate of California as a source of praise from people all over the state, which is equivalent to saying that this praise is all in superlatives. Yet there is always a good reason given for the praise, which is more than can be said about the eulogies of the climate!

HOUDINI

Who has talked on the art of magic from station WOR. But even he, the greatest of living magicians, cannot tell us whence comes the mystery called Radio

In a letter containing much of interest about the men and women heard over the microphone in California, Mr. J. M. McKey has this to say of Uncle John:

> Our most popular station here in southern California is KHJ. While some of this popularity is undoubtedly due to the fine quality of the programs, one of the main reasons is none other than their announcer, known to listeners as "Uncle John." I have never heard any one speak anything but the highest praise for this man. His announcements are always made in a clean-cut, even voice and are to the point. He seems to have no enemies on earth, and is never perturbed or tiresome.

This, following a good many similar comments not only from California but from other states as well, prompted us to send to Uncle John for his photograph to be published this month. But it did not arrive in time. Why not have sent it by air mail, Uncle John? From KGO, California, came a letter via airplane. Why not a picture from KHJ?

Upon second thought, perhaps the airplane route did not occur to Uncle John because he was too modest for it to enter his head that his likeness could be of that much importance to any one. If this is a true surmise, then it but goes to prove that even the best of announcers can sometimes be mistaken. And directors, too. Mr. Daggett serves in both capacities at KHJ.

Of a certain woman announcer in his vicinity, Mr. McKey writes, "She is invariably long-winded and tiresome, as she goes into details in which the public is not interested, and always uses a patronizing tone which disgusts the listener." And of a certain man announcer, "He is good and knows it. In fact he will almost tell you how much better he is than the artists appearing on various programs and what an awful dub you are."

As for the discussion about women speakers that has called forth so many opinions, Mr. McKey adds his views briefly and to the point: "With few exceptions our stations out here employ men announcers, and they are always far superior to the women. I have heard some very fine talks rendered by women, but will say I prefer men all the time."

Yes, there are radio listeners who think for themselves and will never have the "mob mind." By the same token, there are others who, either through intellectual incapacity or laziness, follow the mob in radio as in all other things. They are the ones who, as President Faunce so aptly put it, "will accept the platitudes which are acceptable to all mankind."

Good Things Are In Store for Radio Audiences

WHILE it is the custom of this department to speak of individual performances heard over the radio, such mention is omitted this month because little of outstanding merit has been heard since our last number appeared. This was no doubt due to the inevitable letting down of the programs during the late summer and early fall. But now that the regular season for music and like entertainments is advancing, material for such comment should be ample for many months to come. The advance announcements of the broadcast directors show that some good things are in store for the radio audiences.

But, as usual, the music promises to be the least improved of all the features which are an established part of broadcast programs. It looks very much as if, after listening to a speech on some big subject given by one of authority, we shall still have to hear the announcement:

"The next number on our program this evening will be: 'What Does the Kitty Mean When She Says Meouw?' played by the XYZ Orchestra."

Can you imagine such a thing happening in a lecture hall before a real audience? Then why should it continually happen to a radio audience?

The director will say that he must please all kinds of listeners. Very well, let him please all kinds of listeners. No one is objecting to that. But why try to please them all during one program? One might as well try giving a Shakespeare drama in the theater in conjunction with the latest musical comedy.

However, enough of this for the present—but only for the present. For this is one of the most discussed subjects among owners of radio receiving sets.

Franz Schubert and Robert Burns

THE explanatory remarks that often precede the broadcasting of classical musical numbers are frequently extremely well prepared and given, and then, again, are somewhat confusing. As a case in point, there was the statement made from station WGY, preceding the performance of a Schubert number, that Franz Schubert was the Robert Burns of music.

Granted that we know much more about Schubert's music than we do about the poetry of Burns, nevertheless we cannot see how the one can be likened to the other. Burns was always the Scotsman, and often colloquial, given to the interpretation of life as he saw it in his rather limited scope of vision. Schubert, although born the son of a schoolmaster and raised in bourgeois surroundings, was, as a composer, among the aristocrats of music. As a writer of songs he stands forth as the noblest of them all, and it is significant that he chose, as the texts for these songs, poems of enduring literary quality and some of them masterpieces. With all due credit to Robert Burns, when did he ever conceive, to say nothing of achieving, poems to be classed with such Schubert songs as *Der Erlkönig, Die junge Nonne, Der Tod und Das Mädchen, Der Atlas, Der Döppelgänger, Gruppe aus dem Tartarus*?

In the thirty-one years of his life—he was born in 1797 and died in 1828—Schubert raised song writing to a height that has never since been equalled. Two of his symphonies, the piano *Impromptus* and *Moments Musicals* would alone place him among the Immortals. To compare him with Robert Burns is an estimate incomprehensible to those of us who know his music well.

AN ANTI-PROHIBITIONIST claims that the man who made up a certain short program recently given at station WGY, must also be an anti, for it contained the following numbers:

The Importance of Appetite
Any Old Port in a Storm
The Old, Old Love
In Cellar Cool

These Radio Listeners Had Good Taste

AS LONG as a subject remains of interest in the public mind, it justifies comment among current events. So it is in order that mention should be made at this writing of the winners who contested for honors at one of the closing concerts given by the New York Philharmonic Orchestra at the Lewisohn Stadium of the University of the City of New York during the latter part of August.

It will be recalled by those who listened-in to this concert that five young musicians entered this competition which awarded to the two best among them a début recital in New York this fall. As such a début costs anywhere from $750 to $1,000, the competition was worth while to these aspirants for a

concert career in this country. Before each contestant's performance, and after it as well, announcement was made that from the votes of the audience present at the Stadium—close to ten thousand people—and of the radio audience, the decisions would be made.

It seemed as if any listener-in who had heard enough music to have mature judgment could not hesitate in making these decisions. Ignace Hilsberg, pianist, and Miron Poliakin, violinist, being the ones that quite eclipsed the others through their all-round proficiency. But what would the public think? That was the question. There were two singers on the program, and it is the general belief that a vocalist of average excellence is always more popular with the masses than an instrumentalist of exceptional merits.

But it was not so in this case. The pianist and the violinist just named won by a large margin.

Yet people are forever saying that you must bring yourself down to the level of the public if you would succeed. The truth is, the public practically never fails to respond to the best if given opportunity to pass judgment upon it.

There is a moral in this for makers of radio programs, a moral so obvious that it does not need expression in words.

Another Plan to Pay Radio Artists

THE announcement made recently in the *Musical Courier*, "Radio Performers Are Hereafter to Be Paid," was somewhat premature. It was based on the published opinions expressed by the committee appointed last spring by Mr. E. F. McDonald, Jr. of Chicago to devise some plan whereby this much needed reform could be brought about. One of the chief proponents of the plan is Mr. Paul B. Klugh, executive chairman of the National Association of Broadcasters. In its public statement, the committee went on record as endorsing the paying of radio performers as a means toward raising the standard of broadcast programs, and suggested a way whereby this change might be brought about.

But the desired goal has not yet been

—Thomas Coke Knight, New York

JOSEPH KNECHT'S WALDORF ASTORIA DANCE ORCHESTRA

Talk about a performance of Hamlet without the Melancholy Dane! What about an orchestra *sans* the instruments? It's up to those who see this picture to guess Who's Who so far as who plays what is concerned. The only easy guess is the man at the piano, who is Mr. Knecht himself. The men look as if playing a joke on us by trying to make us think that one instrument can make an orchestra although one swallow never made a summer. They are frequently heard through station WJZ, New York

reached. It will be, however, and soon. There is absolutely no question as to the dissatisfaction of large numbers of people with radio programs as they are now transmitted. The committee that is trying to solve this problem is working along the right track, though there is some question as to the practicability of the plan.

Ho! For a Contest of Dramatic Readers!

MRS. R. J. QUIEN, dramatic reader of Camden, N. J., who has broadcast from various stations in that vicinity, has risen up in wrath at the statements made in this department by our contributors against women radio speakers in general and dramatic readers in particular. She tilts her lance especially at Mr. Corley Kirby of station WWJ who came out just as hard against the women readers heard through his station as those heard through other stations. Knowing Mr. Kirby, we are quite sure that he would stand his ground and give good reason for it against the onslaughts of an army of critics. And enjoy the controversy too.

"I wish," writes Mrs. Quien, "that Mr. Kirby could read some of the letters I have received about my broadcast performances, and then perhaps he would not be so prejudiced against all women readers who broadcast, and remember the old saying, 'All rules have an exception.'"

But this is not all. Mrs. Quien comes forth with a challenge. We quote her regarding this discussion that has been going on and is still being merrily waged in this department by our readers:

> Since there seems to be so much discussion, why not suggest to WEAF, New York, or some central station to have a dramatic readers' contest? *I* should love to appear some evening with a male competitor and both cover the same line of dramatic work, humor, pathos, and melodrama. Let the public decide whether they like it. I would contest with *any* male competitor.

So much for the challenge. Now the question is—who will accept it? We await the answer. Or should we say "answers"?

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MYRNA SHARLOW

An American dramatic soprano who has gained many admirers among the patrons of the Chicago Civic Opera Company, of which she has for eight years been a member. She has broadcast a number of times from Chicago stations and is among those who believe that the radio will become a great musical factor in American life

The Impressive Hour When Pershing Spoke

ON THE morning after Defense Day, the majority of the papers throughout the country carried front page stories of how the two Chicago murderers, Nathan Leopold and Richard Loeb, spent their first day in the penitentiary, even what they ate for dinner being told in detail. And in some of these papers, no mention whatever was made of the fact that on the evening of Defense Day probably the greatest achievement in human communication ever known in the world was accomplished. This was the conversation carried on by General Pershing at Washington with four generals of the United States Army, located respectively at New York, Chicago, Omaha and San Francisco, heard by millions of radio listeners.

History was made during that hour when General Pershing as their commanding officer bade

farewell to these generals with whom he had long been associated. But it was considered insignificant as a news item compared with the dinner menu of two murderers. Yet it will remain in the memory of some of us as about the most impressive hour ever lived through. All those who listened-in owe a lasting debt of gratitude to the American Telegraph and Telephone Company and to the various broadcast engineers who brought about this miracle as their contribution to Defense Day.

"Thank You For Thanking Me"

IT IS not unusual to hear people complain that they have written this or that broadcast station telling of their enjoyment of this or that feature, and received no reply. If they would look at the matter in a general rather than a personal way they would realize that a broadcast station would need to employ, at much expense, a special staff to answer such correspondence. And, for that matter, when we thank a person for doing us a favor we do not expect the reply, "Thank you for thanking me." Why then expect this of a broadcast director?

Among Other Things. . . .

AT STATION WBZ, Springfield, Mass., experiments have been made to find out whether the radio listener does or does not like to hear the noise of the crowd when big public events are broadcast. So far as our personal experience and knowledge of the radio public goes, the answer is "Yes!" If the noise of the crowd is not heard now and then the real atmosphere of the event is wholly lacking. So let us hear the audience every time, WBZ!

FIRST, let it be said that the announcers at all the broadcast stations conducted by the General Electric Company are unexcelled in the quality of their work, which is always clear, concise, and characterized by that good breeding one has a right to expect but does not always find in a broadcast announcer. This being so, one error made by these announcers is conspicuous. Why do they say, "Gen-*a*-ral *A*-lec-tric" instead of "Gen-*e*-ral *E*-lectric"?

YOU never can tell how reforms may be brought about. Sometimes the unconscious indirect method does what the consciously applied direct method fails to accomplish. All of which is preliminary to saying that if broadcast stations keep on giving occasional programs of old-fashioned dance music the old-fashioned dances may come back into favor.

MAJOR A. G. RUDD

The polo expert of the U. S. Army who broadcast the International polo games direct from the Meadow Brook Club. Authority sits well upon him and we would trust him to get away with anything he undertook. We've an idea he's tackled easier jobs than broadcasting a polo match. Some speed, that takes, before the microphone

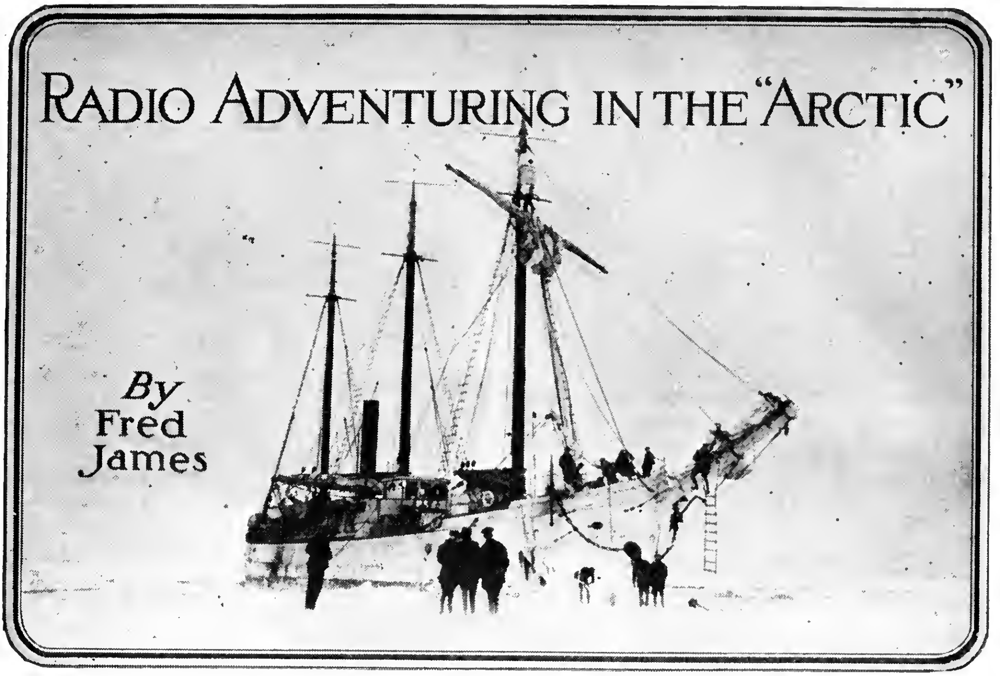
MOTION picture stars are, with rare exceptions, better seen than heard. It is a bit risky for them to reach the public through the radio because their glory is dimmed as soon as they open their mouths. A case in point is the famous film star who, speaking not long ago through a Chicago station said, "Being as there's no motion picture studio in this city"—etc.

ANY day or evening you can tune in and hear from one station or another some of the latest books discussed. It may interest the broadcast directors to know that many people enjoy this feature who are not among those inclined to write letters expressing their commendation.

THE young woman who, each evening at 7.30, from station WBZ, Springfield, talks to the kiddies is one of the star radio entertainers along this line. She gives the children such worthwhile stories that they are also enjoyed by grown-ups, which is the test that all stories for children must meet before they can be called literature.

Radio Adventuring in the "Arctic"

By Fred James



NEITHER Greenland's icy mountains nor India's coral strand are now remote and isolated. Folk thereabouts are likely to be pretty familiar with the latest, from the up-to-the-minute developments in the presidential election campaign to the harvest returns in all parts of Canada. Such is the extent of the mystic bond of radio.

Since the Canadian Government ship *Arctic* left her berth in the St. Lawrence River at Quebec early last July, *en route* on a trip to the Arctic Archipelago, she has been in touch with the outside world from the time she left and will continue to be so until she returns next October, assuming, of course, that no serious accident happens. This stout little vessel, built back in 1900, has been tripping up the Arctic Seas these twenty years. This year the *Arctic* has her two regular radio equipments consisting of a standard 600 meter 2 KW spark equipment and a continuous wave transmitter working on 2,100 meters, with which they keep in touch with the long wave ship station at Louisburg, Nova Scotia, and in addition a short wave ICW outfit which will transmit on wavelengths between 100 and 150 meters. The installation of this short wave equipment is for the purpose of carrying on tests with the United States and Canadian amateurs to ascertain how short wave signals come through from the far north during the full daylight period in the land of the Midnight Sun.

The operator on the *Arctic* is Bill Choate of Toronto, owner and operator of Canadian amateur station 3 CO. An enthusiastic youth is this Bill Choate, so his superiors say. He hoped when he left to meet another Canadian, Donald Mix, the operator on Donald MacMillan's ship *Bowdoin*, somewhere tolerably near the North Pole, but up to the end of August he had not been able to do so.

The interesting facts about the watch the CGS *Arctic* is maintaining on short waves are:

Call Sign VDM
Wave Length 120 meters,
Eastern Standard Time,
Daily except Wednesday 11 p.m. to Midnight
Saturday only 11 P.M., to 3 A.M.

The radio branch of the Canadian Government, Department of Marine, has authorized all Canadian amateur stations to use a wavelength of 120 meters during the foregoing hours for the purpose of communicating with VDM.

The test transmitter comprises two admiralty T4A tubes, operating on 8,000 volts on the plate with an output rating approximately 500 watts per tube, using a standard Meissner circuit. In order to make the

transmission as penetrating as possible, no filter system is being used and the characteristic 480 cycle note will enable amateurs to place VDM immediately they hear Bill Choate's note, even if they do not get his call sign.

THE MISSION OF THE "ARCTIC"

THE CGS *Arctic* went into the Arctic Archipelago, whose islands measure more than 500 square miles, and spread over an area of more than 520,800 square miles, to relieve outposts of the Royal Canadian Mounted Police and other Canadian Government officials who have spent one or two years in the Arctic Circle. She will establish new police posts, customs houses, post offices, and complete numerous surveys and comparisons of previous observations.

There is, it seems, an abiding passion on the part of the Government of Canada for establishing and maintaining the majesty of the law even to its most remote outposts. Establish a police post at the North Pole or anywhere else with a red-coated mountie in charge and law and order will prevail. The Eskimos have learned this. Noo-Koo-Lah, one of these Eskimos, killed a Newfoundland trapper in the neighborhood of Pond's Inlet in Baffin Bay two years ago. Last year he was brought out of the Arctic and is now languishing in a Canadian penitentiary. The Canadian Government also has some commercial interests in the Arctic that need protection. There are reindeers and musk ox by the millions up there that may some day play a part in the world's food supply. Trading companies under different flags are getting busy in some favored places and they need, it seems, both protection and watching.

The expedition this year is in charge of F. D. Henderson of the Northwest Territories Branch of the Canadian Department of the Interior. He will go as far north as Ellesmere Island, 823 miles from the North Pole, the farthest point reached last year by the Craig expedition in the *Arctic*. Captain J. E. Bernier, the master of the *Arctic*, is now making his two hundred and fifty-eighth voyage. For fifty-five years he has been sailing and steaming up and down and across the seven seas and many of the waterways running into them. For twenty years he has been going into the far north on the good ship *Arctic*, a three-mast top-sail schooner of 650 tons gross and 436 tons net, 165.4 feet long and 37.2 foot beam. She has a triple expansion engine of 275 horsepower and can make seven knots under steam in clear water.

She has three masts, 80 feet high, and this year a short topmast has been added to the mainmast to give more clearance between the antenna wires and the mass of rigging wires which sailing ships are compelled to carry.

ROYAL CANADIAN MOUNTED POLICE

Going aboard the *Arctic*, bound for the far North, to take duty at one of the solitary posts there. The admiring crew on the dock may be speculating as to whether or not these stalwart three will "get their man"

The working of the radio set in a ship fitted with sail is not as satisfactory as in a steamship on this account. The antenna wires have to be erected in a position where they will not foul the sails, booms, or running rigging, and the heavy steel guys necessary to support the spars drain away a lot of the energy which would otherwise be radiated. Since the *Arctic* is built of wood, Bill Choate has to cast an anxious eye over the side as soon as they run into Arctic floe ice. And his chief concern is the welfare of the 200 square feet of copper plate, on the ship's bottom, which constitutes his main ground connection. If he is lucky, he escapes. If the ice nicks off the copper, he has to rely on the engines and propeller for his connection, and there will be a lamentable drop in the efficiency of the transmission.

RADIO EXPERIMENTS IN ARCTIC SEAS

IN ADDITION to the regular tests with Canadian and American amateurs, special tests have been arranged with station KDKA through the courtesy of Mr. George Wendt of the Westinghouse Electric and Manufacturing Company. Experiments occur every Monday

the far north at Craig Harbor and Pond's Inlet were equipped with radio receiving apparatus last year but until the *Arctic* returned early in this year no data was available as to what concerts, if any, they were able to receive up there last winter and the full details will not be known until the *Arctic* is back in Quebec.

CANADIAN MOUNTED POLICE USE RADIO

THE battery problem is a serious one in the case of these sets in that supplies are only taken in once a year. The receiving sets at the Police Posts are equipped with Northern Electric peanut tubes and use special batteries prepared by the Eveready Battery Company for filament lighting. In addition they are provided with 300 ampere hour Edison-Lalande primary batteries with ample refills to see them through. For B batteries they are provided with both Burgess and Eveready standard units and in addition an adequate supply of what are termed "inert cells," which are made up specially for the Canadian Department of Marine and Fisheries by Siemans Brothers in London, England. These latter are small dry cells containing no liquid. To put them in operation, the cells are filled with water when they are good for the normal life of an ordinary B battery.

It will be interesting to hear how these different batteries have made out under the severe climatic conditions prevailing in those latitudes.

The Police Station is also supplied with the portable long wave receivers specially built for

WHAT HAPPENED TO ONE POLAR BEAR

When the crew of the *Arctic* went bear-hunting. It does not seem such a difficult task to hoist a fairly weighty bear over the side, as the photograph shows. The "three men in a boat" appear to enjoy the rather novel occupation of towing the defunct bear

night on their short wave set. KDKA is using its experimental call sign 8XS when working with Choate. The results obtained from the short wave set while the *Arctic* was proceeding down the Gulf of St. Lawrence were very satisfactory, American amateurs as far west as Oklahoma having been worked. They have heard KDKA on short wave transmission, eleven degrees from the North Pole.

Great rivalry exists between the Pacific and the Atlantic Stations. Amateur operator Jack Barnsley at Prince Rupert has rather put it over the Atlantic Division in working with Mix in the *Bowdoin*, but IAR and other notable amateurs in the vicinity of Halifax have been holding Bill Choate to the last gasp.

In addition to the regular code apparatus aboard the *Arctic*, the Westinghouse Company has provided her with special short wave receiving equipment for receiving the concerts transmitted on KDKA's short wave. Recent tests have indicated that Captain Bernier and his crew have been able to enjoy the short wave concerts long after the regular broadcast transmissions on the higher wavelengths have faded away.

The Northwest Mounted Police Posts in

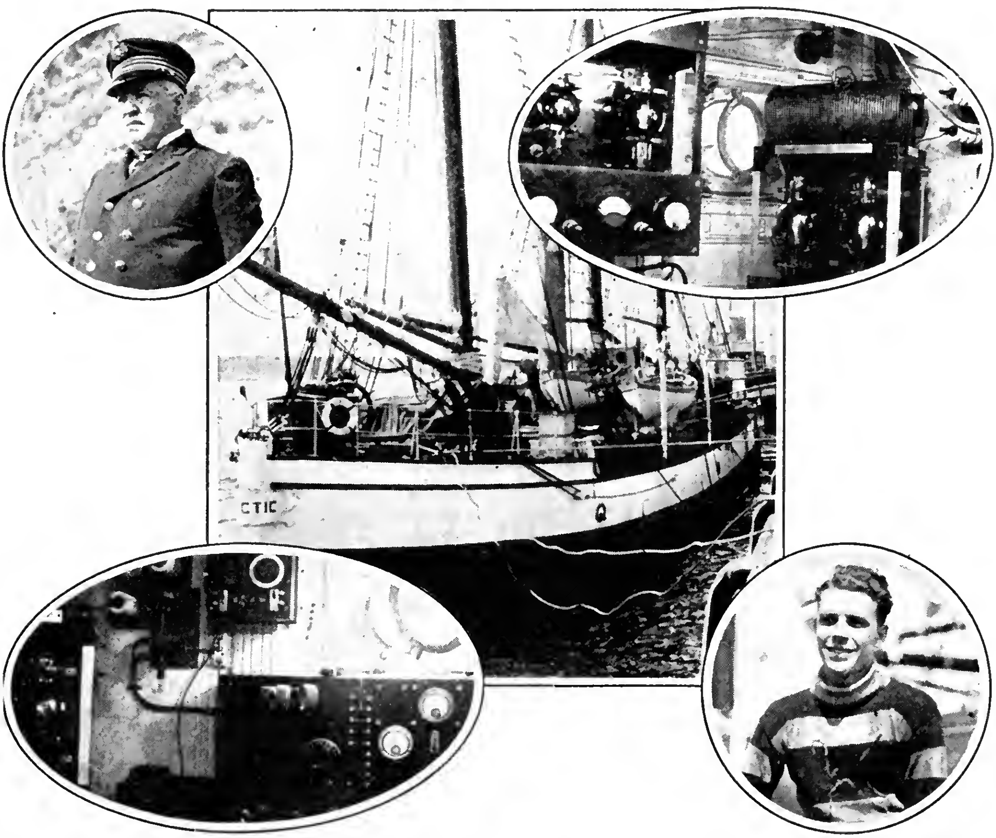
surveyors by the Radio Branch, Department of Marine and Fisheries, Ottawa. Strong long wave signals are received up north from the high power stations in the United States and Europe on this receiver, and with the numerous press schedules in effect the Police Posts frequently receive news items actually before they appear in our own newspapers. Last year the report of the death of President Harding was received by the *Arctic* within a few minutes of its occurrence. By some accident the *Bowdoin* did not receive this press message and it was not until she encountered the *Arctic* about a week later that her crew became aware of their country's great bereavement.

While the *Arctic* plans to be back at Quebec sometime in October, she has aboard supplies sufficient to last for more than a year. About the first point of call she made on her outward voyage was Godhavn, Greenland, where there is a Danish settlement, where she arranged to leave mail for Captain Donald A. MacMillan, the American explorer on the *Bowdoin*.

Among the party on the *Arctic* are six men of the Royal Canadian Mounted Police, who are going to man a new post farther north than any police post has yet been established.

NO CRUSHING CROWDS HERE

THE Arctic Archipelago is one of the greatest realms of unexploited treasures of natural resources in the world. Whether the Arctic Archipelago will ever be of economic value is still uncertain, but it is quite probable that before very long a radio station will be established in the farthest north which will be in communication with the uttermost ends of the earth. Meanwhile try your luck through the ether and listen for VDM.



THE CANADIAN COAST GUARD SS "ARCTIC"

Her Captain Bernier (upper left circle), and radio operator Bill Choate (lower right). The sturdy little vessel, which has voyaged up the Arctic seas for twenty years, is now on another trip, more notable than preceding ones because of extensive radio experiments being carried on with broadcasting stations and amateurs on short wavelengths. The top photograph shows the transmitting equipment which is a 2100 meter, one kw continuous wave set, and a 120 meter cw, two kw transmitter. The receiving equipment is shown in the lower photograph

Will This Circuit Ever Work?

Theoretically, the Receiver Described in this Article is Possible: the Addition of Super-Regeneration to the Roberts Circuit—If it is Possible, the Circuit Should Surpass any Receiver Now Known, Using Two Tubes—Here is the Technical Problem: Can You Make it Work?

BY WALTER VAN B. ROBERTS

ONE of the questions most frequently asked about the two-tube circuit described by the writer in the April, 1924, number of RADIO BROADCAST is: "Will that receiver work with a loop antenna?" Unfortunately, the circuit is not sufficiently sensitive to produce good loud-speaker results with a loop antenna except in the case of very strong signals. Not only is this true, but if the loop is placed near the set, unwelcome oscillations occur when the loop is turned so that sufficient magnetic coupling is established between it and the other coils. Hence, the circuit as it stands cannot be recommended for use with a loop.

LOUD-SPEAKER VOLUME ON A LOOP AND TWO TUBES?

THE idea, however, of obtaining good loud speaker volume with two tubes and a small loop is very intriguing and it is proposed to outline an arrangement that looks as if it might turn the trick. The writer has tried out the arrangement only in a very sketchy fashion, and although the results were very promising, it must at present be considered as founded upon theory alone. To make a thorough investigation into the best method of actual construction for this circuit would take much more time than the writer has available, and so it is hoped that some of the many enthusiastic and able experimenters who read this magazine may take up the constructional development work and in due time add another to RADIO BROADCAST's list of Knock-Out, non-radiating receivers.

> **Not a How-to-Make-It Article**
>
> Walter Van B. Roberts, whose articles on the super-heterodyne, super-regenerative, and remarkable reflex circuits have been a feature of RADIO BROADCAST for many months, is, without question, one of the most capable of our practical radio engineers.
>
> He has vision, and his vision is tempered by a scientific background which adds practicality to his ideas. In this article, Mr. Roberts outlines some very interesting and exceptionally valuable fields of experiment for those whose knowledge and experience is sufficient for such work.
>
> This is not intended to be a how-to-make-it article. We cannot undertake to answer questions about it. Unless the experimenter is able to figure proper inductances and capacities and similar problems of radio design, we do not advise that he attempt the solution of this problem.—THE EDITOR.

Briefly stated, the idea is to make the above-mentioned two-tube set (described in this magazine for April, and May, 1924, and with other modifications, in August and September) sufficiently sensitive for loop reception by substituting super-regeneration for regeneration in the second tube, and to take measures to prevent magnetic coupling between the loop and other coils in the set. It may also prove necessary to take special pains to by-pass as nearly as possible all the interruption-frequency current around the audio-frequency transformer in order to avoid overloading the first tube with this frequency. The circuit would then be something like that shown in Fig. 1. The chief characteristics to be expected of such a circuit when properly built are:

1. It would make a truly portable set.
2. Its sensitivity could be made greater than that of a simple super-regenerative circuit on account of the stage of radio-frequency amplification.
3. Its selectivity would be greater than that of any ordinary super-regenerative circuit because the loop circuit is never damped.
4. Its volume, for any signal reasonably above the static level, should be ample for a medium-sized room, and
5. Its quality should be good because its sensitivity should be so great that the

super-regenerative action would rarely need to be pushed very far.

In general, this circuit, if properly built by a constructor who is familiar with the principles involved, should be satisfactory for signals above the interference level, and where the utmost selectivity is not required. For very long distance work, however, it probably would not give as good year-round results as the present two-tube regenerative arrangement using a good outdoor antenna.

PROBLEMS CREATED BY THE LOOP

THERE are several methods by which magnetic coupling between the loop and other coils may be prevented. If this coupling is not completely eliminated, or if the capacity coupling is not completely balanced out by the neutralizing condenser, the strong oscillations in the circuit of the second tube will force oscillations in the loop circuit, and these latter oscillations, persisting in the low-resistance loop circuit will re-excite the super-regenerative circuit after its periodical interruption, even in the absence of any incoming signal, and thus render the set inoperative. Hence the necessity for the care in eliminating all the coupling between the two circuits.

Moving the loop some distance from the set is not an elegant solution of the problem, and it would be difficult mechanically to place the loop on the set so that it could be rotated without introducing any coupling in any position. It might be possible, but not easy, to wind all coils on toroidal forms or their equivalent, so as to eliminate all external field. Shielding, of course, may be added to any scheme used, provided the shielding itself does not introduce coupling. Probably the simplest and best method of all would be to make the loop an integral part of the set, fixing its position once for all, then rotating the whole set whenever during operation it is desired to rotate the loop.

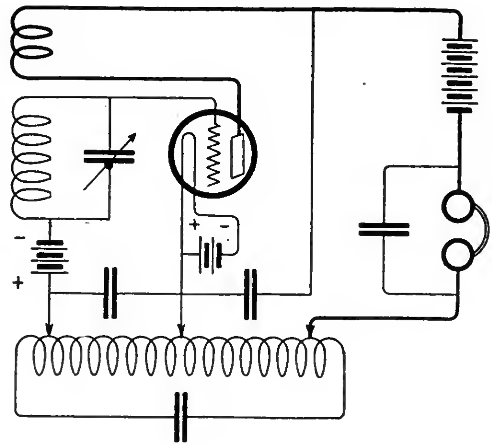


FIG. 2

One form of the Armstrong super-regenerator which every one admits does more work with a single tube than any other known circuit

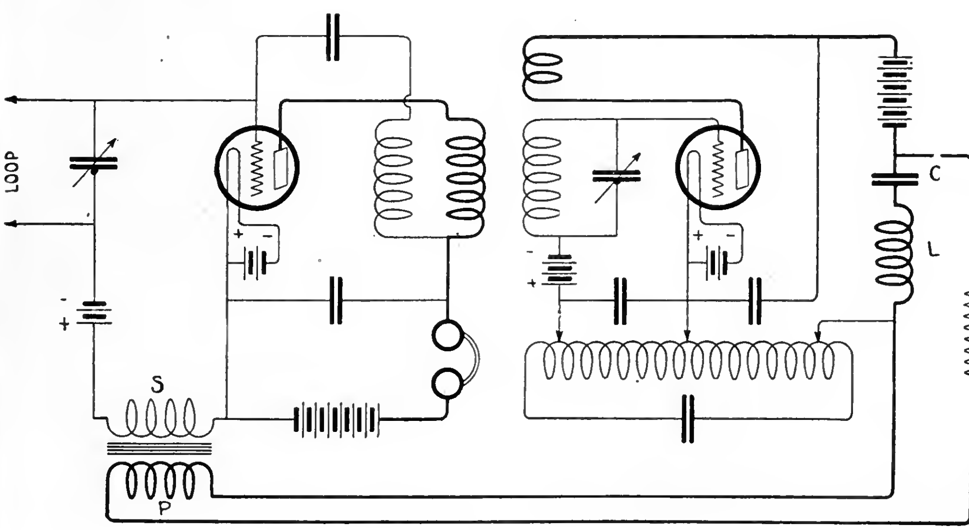


FIG. 1

Here it is, all in a nutshell. Tuned radio frequency of the neutralized type — super-regeneration of the single tube type — audio amplification by the reflex method. This circuit has infinite experimental possibilities that should result in the development of a remarkable receiver. Can you make it behave?

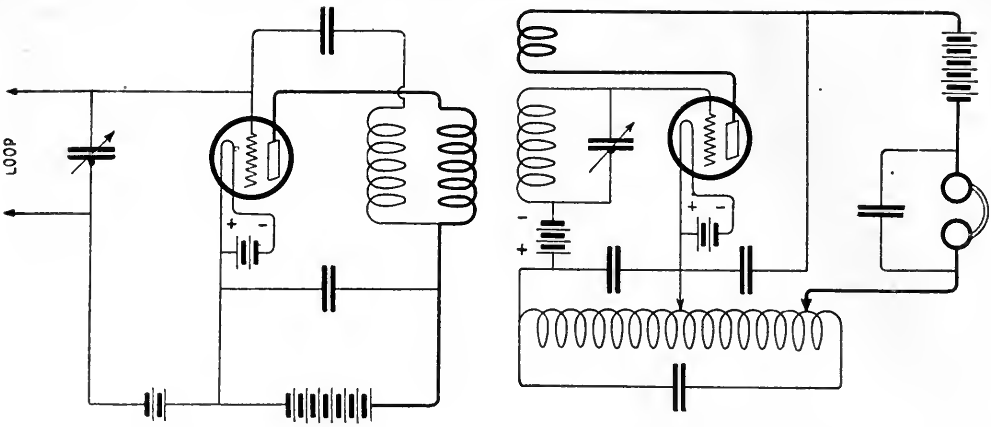


FIG. 3

Here is a circuit which Mr. Roberts offers as a possibility. No constants are given because they are unknown and must be determined by experiment. The left hand half of this circuit is almost a direct copy of the R. F. section of Mr. Roberts's now famous two-tube set—the right half is a super-regenerative circuit of practical design. After these two have been joined satisfactorily you may start on Fig. 1, which is the last word

HOW TO SOLVE THE PROBLEM

IN WORKING up a circuit such as this, the difficulties should be overcome, one by one, whenever possible. A good procedure would be to start with the super-regenerative circuit alone, as shown in Fig. 2, which differs from that published by the writer in the May, 1923, number of RADIO BROADCAST, in that provision is made for varying the grid and plate circuit couplings to the interruption frequency oscillation circuit independently of each other by means of a large number of taps on the inductance. Local stations can readily be received without a loop, the grid coil being sufficient to pick them up. After this one tube "super" is working perfectly, it is time to put the radio-frequency amplifier ahead of it, as Fig. 3 suggests. This, when properly adjusted for zero coupling, should make a tremendous difference and the set should now give loud-speaker volume with greatly improved selectivity.

When the builder is satisfied with the operating characteristics of this set, the final step may then be taken. This is the reflexing to obtain a stage of audio-frequency amplification. At this point, it may prove necessary to try some such filter arrangement as shown in Fig. 1. It may even be necessary to shift the position of the primary of the audio transformer in the circuit so as to bring it to ground potential. In this figure, C is as large a capacity as can be used without spoiling the quality, and L is the inductance required to annihilate the reactance of the shunt circuit LC at the interruption frequency. The series resistance may help to make the by-passing more complete.

The above hints on construction and experimental procedure are rather indefinite and unaccompanied by values for the various quantities, but they will be more than sufficient for experimenters capable of doing such work successfully. It is not desired to lure others into so difficult and tedious an undertaking.

HOW A PACK RADIO SET FINDS TROUBLE

ROBERT H. MARRIOTT, a former President of the Institute of Radio Engineers, now an engineer on the Pacific Coast, has written a very interesting story about how he uses a pack radio set to "shoot" such radio troubles as arise from radiating receivers and bad power lines. The article is written in Mr. Marriott's interesting style and is full of ideas and suggestions. It will appear in an early number.

The Story of Powel Crosley

Often Called the Henry Ford of Radio—How the Search for a Child's Radio Set Started an Immense Business

By MYRA MAY

SOMETIMES it really pays to gratify your children's desires. There have been several instances in which the wish of a child has resulted in the discovery of a good toy, or the invention of some delight to the heart of some youngster. Who knows but that through the doll Jane wants or the bicycle Jimmy dreams of, fame and fortune may seek you? Consider the case of Powel Crosley.

> **It All Started With an Idea**
>
> Powel Crosley, as Miss May tells in this story, found that radio equipment a few years ago was entirely too expensive. And so, after some business troubles, he started out to make radio sets which could be purchased by the "average man." Some of Mr. Crosley's admirers have called him the Henry Ford of radio. What is certainly true is that the idea of large scale production of not-too-expensive radio equipment satisfies a decided public demand. Mr. Crosley is an interesting person, both because of himself and of what he has done; and Myra May has quite caught the spirit of his personality.—THE EDITOR.

Crosley's little boy wanted a radio set and, like all fathers, Crosley agreed to buy one for his son. The boy was only nine years old but already he was on familiar terms with antennas, inductances, grids, B batteries, and the rest of the jargon of the true radio fan. He planned a set that would bring in distance and anticipated hearing all the baseball games right at home; he even invited his young friends to enjoy the broadcasting as his guests.

So on Washington's birthday, 1921, Crosley and his son set out to buy the long promised outfit. The Precision Equipment Company offered them a small receiving set for $130, far too expensive a one for a father in moderate circumstances to buy his son. There was nothing cheaper to be had and the father broke the news to the youngster that they would have to postpone buying the "toy." The boy, remembering his nine years, winked back the tears and mastered his disappointment. For a compromise, however, Crosley bought the child a practice key buzzer and a text book on radio.

Thereafter father and son spent their evenings mastering the intricacies of wireless. The boy studied his lessons in the afternoons so that the evenings might be free for the alluring radio. Crosley himself fell under the spell of these after dinner sessions. Within a short time they had a working knowledge of the principles of wireless. Crosley soon bought a simple crystal set. His antenna was made of hay wire.

"Every rock crusher around town came in like a ton of brick," Crosley says of that outfit. "We couldn't get any music so we added an audion detector and heard a concert seven miles away! That evening is one of the red letter days in my life. I don't know whether my son or I was prouder of the performance. I unconsciously joined the class of radio bores. I told everyone I met about the distance our home-made set had covered.

"Finally the boy and I, by this time hopeless radio fans, bought a three-barreled multicontrol set. When the wind was blowing in the right direction, we frequently heard Pittsburgh—a remarkable achievement from our home in Cincinnati, we thought. Our total outlay on our set that the boy and I had made, had been only $35. The new outfit was an extravagance we permitted ourselves now that we were going deeper into the mysteries of wireless. Moreover, we had gained a good knowledge of radio, could rig up a set and were able to diagnose our trouble when the apparatus wasn't working properly.

THE HENRY FORD IDEA IN RADIO

ON THAT Washington's birthday, I wondered how other men on salaries as small as mine could afford to buy radio sets at the prices I was asked. I knew that ex-

pensive equipment such as I had been shown was out of the question. I knew that many men lacked the mechanical ability or the desire to make their own outfits. Yet I was confident that radio was not a rich man's toy and I believed that it should be within the reach of everyone.

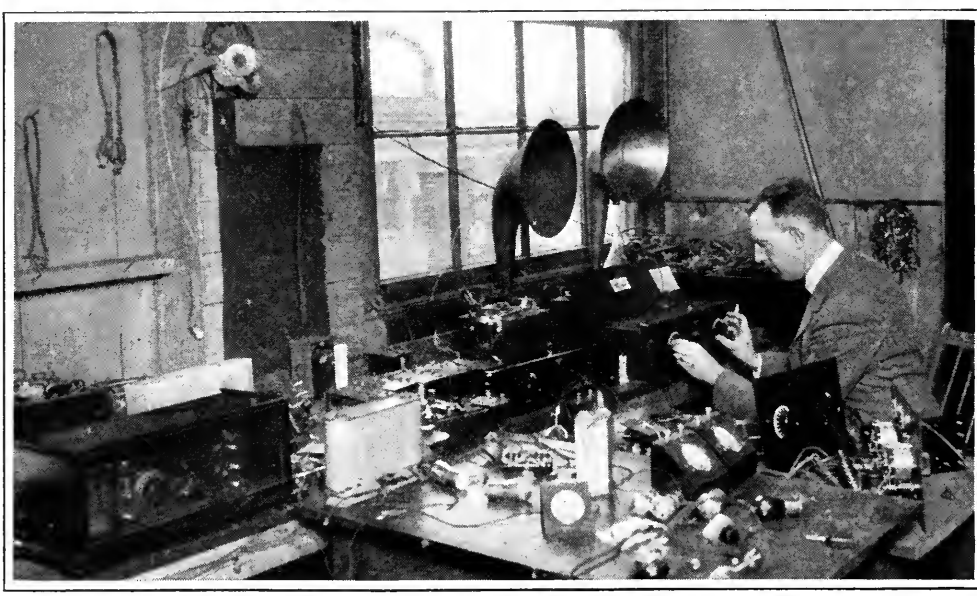
"As my boy and I tinkered with our home made set, the idea was born in my brain that a big market awaited inexpensive radio equipment. The possibilities of cheaply manufactured apparatus on a production basis appealed to me more and more. I was sure that here was an untrodden field in a brand new industry. There the opportunity was, waiting for someone to realize its value. I decided to go into the radio business on a very limited scale."

Crosley, at this time, had a small wood working factory where he manufactured phonograph cabinets. The slump of 1920 had hit his business so hard that trade was practically at a standstill. It was a godsend, therefore, to be able to use the idle machinery to turn out radio cabinets. For a time he made the cabinets for other companies, but his son's enthusiasm for radio finally convinced the father that this new art was no fad, that it was an invention here to stay and that it had unlimited possibilities. Instead of making cabinets for other concerns, he began to sell them direct.

Through contact with the manufacturers of radio parts, he discovered that there was no popular priced equipment on the market. From the time that he and his son had bought a book of directions, and started to make their own set, Crosley had seen the need of inexpensive parts. The lack of a moderate priced vacuum tube socket particularly impressed him. Although a novice at radio, he was a trained automobile mechanic, so using his knowledge in a new capacity, he designed a socket made of porcelain. Its success led him further in this new field. He produced a book-type variable condenser made with two flat pieces of wood and working on a hinge. Then he manufactured a special switch. Now that he turned out cabinets, sockets, condensers, taps, and switches, the next logical step was to make a complete set.

"Our first outfit," Crosley relates, "was a simple crystal set." It was a very simple set, but it laid the foundations of a million dollar concern and carried out a precept that said experience had taught him. He had learned the wisdom of beginning a new business on a small scale, although it had taken several failures to do it.

At the time he graduated from college, he wanted to go into the automobile business. His father was a wealthy attorney of Cincinnati, and wished his son to join his firm. Young Crosley, accordingly obediently went to law



A CORNER IN THE TESTING LABORATORY
Of the Crosley Manufacturing Company. Mr. Crosley is testing the operation of a radio receiver picked from the stock

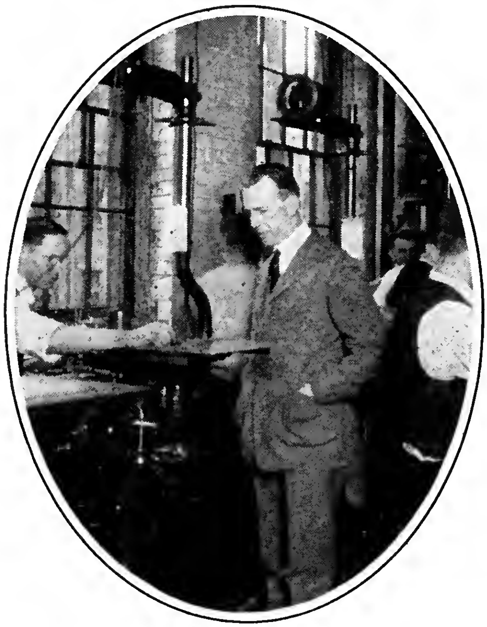
school. Once out of college, however, he announced that he was going to make mechanics his life's work. His father answered this by telling him he must make his own way in his chosen profession.

So this likely young lawyer with automotive leanings got a job as a chauffeur for a private family. Crosley did just that. He had some valuable experience for a few months and learned what it is that endears a motor to a mechanic and a chauffeur. And he acquired the consumer's point of view.

CROSLEY AS AN AUTOMOBILE PROMOTER

THEN on his twenty-third birthday he decided to test an idea that he had had for some time. He believed that there was a big market for inexpensive six cylinder automobiles that would retail for about \$1,700. So he organized a company and manufactured his first car. Interest was aroused everywhere. The young man seemed to have hit on an idea that the world had long awaited. It seemed as though success must crown his efforts. But that first car was the one and only that the company ever manufactured. Not long afterward, the defunct corporation was buried with appropriate ceremonies.

"Not enough capital," Crosley explains succinctly. "I had already borrowed money to organize the company and I could not secure additional funds. I think that failure was the greatest diappointment in my life. I have never counted on anything so surely and taken a reverse to heart the way I mourned that automobile disaster. From the time I was in college, I had planned to be firmly established and on my way to becoming a millionaire at the age of thirty. I had fondly imagined that I had found a short cut to fame and fortune and that at twenty-three I could go to my father and say 'I have succeeded!' But then I was utterly discouraged. Never had the future looked so dark.



ON A TOUR OF INSPECTION

Mr. Crosley's plant is one of the largest of the independent radio manufacturers. Three years ago, he came to this same plant to purchase a radio receiver for his son. He now owns it. The story of how that came about is most interesting

"Still despondent, I drifted to Indianapolis. That city was just showing signs of becoming a great automobile center. Here I got a job as a driver for the Carl Fisher Company. You may have heard of it; they are prominently identified with the Prestolite business. My knowledge of motors and sheer nerve put me on the payroll of the concern and when the great Indianapolis Speedway was opened, the company selected me for one of their entries.

"A few days before the race I broke my arm cranking an automobile and thus was unable to drive a car. Lady Luck seemed to have turned her back on me forever. As for Opportunity, I decided that she had forgotten my address and so couldn't knock at the door. In quick succession, I worked as assistant sales manager, copy writer, and manager for several automobile companies."

Crosley was trying to find himself, searching desperately for the right place. But as he neared the thirty mark, he was not a whit closer to the millionaire class than when his own company had gone broke, nearly seven years before. He was still not established; he was still not ready to go to his father with the news of his success. If any one had wanted to bet that Powel Crosley was to be a millionaire in five years' time, he could have had 100 to 1 odds and the sympathy of the onlookers for wasting his money that way.

It did not seem that he was ever to realize his ambitions. Returning from his wanderings in Indiana to Cincinnati, his home town, he again organized an automobile company. This time the chances for success looked good. He arranged to handle the designing, the production, and the sales end of the pro-

posed business while the other partners advanced the money. It was an ideal combination with only one drawback. They lacked sufficient capital. For the second time, a company he had organized died for lack of money. Crosley, who had lost his youthful illusions about any short cut to success did not take his second defeat as hard as the first.

SUCCESS AT THIRTY?

HIS ambition to be firmly established by thirty looked as far off as ever. Undismayed he once more tried to capture the elusive fortune. In 1913, the popularity of cycle cars seemed to offer a splendid field for a new inexpensive make. Crosley organized another company, but the concern languished and died just as its predecessors had done. The autopsy revealed the same fatal lack of capital as the cause.

"It was then that I woke up" Crosley says. "I thought that I could finance million dollar corporations on small amounts of capital that did not even belong to me. I promised myself then and there not to attempt more than I could safely manage, not to run my business on other people's money, and above all, to be strictly independent in my financial dealings. I made up my mind that I would finance myself even though I had to run a popcorn stand and that I would quit trying to fly too high on wings that were too big for me."

But Crosley was a born organizer. Although he stuck loyally to his resolution to manage his own affairs without outside help, the popcorn stand was not in his scheme of life. He started a mail order business and when it prospered he bought out one of his clients who sold automobile specialties. Next he purchased a printing plant where he ran off the advertising matter required in his other lines. And as if he were not already sufficiently engaged, he took over a wood working factory where he made phonograph cabinets.

POWEL CROSLEY AND GEORGE LEWIS

Mr. Lewis is the general manager of the Crosley Company

Every time a new business loomed up on Crosley's horizon, he saw the pot of gold. The idea of supplying an inexpensive article was inherently sound, though he applied the principle in many different trades. He seemed to be drifting when he went from one line of work to the other; in reality, he was learning the limitless possibilities of medium priced goods, in high priced lines.

After each successive failure, he would rebound from the disappointment with the conviction of still another business which would make the family fortune. When this new company began paying surtaxes, he would buy his wife the long promised Rolls Royce and chinchilla coat, and as the day of his ultimate success seemed farther and farther removed, his wife never lost faith. She was sure that some day Powel Crosley would join the millionaire class and then she would have the Rolls Royce and the chinchilla coat. Her belief in him set him on the road to gratify his ambitions.

With all of the ventures he was running, Crosley was still not satisfied. He entered still another field. This time he found the one that led to the pot of gold.

THE CROSLEY IDEA

HE TRANSFORMED his wood working factory into a plant to make inexpensive radio parts. Then he introduced the making of medium priced parts and gradually built up his gigantic concern. But he was perfectly content to start in a small way and gradually increase the business as finances warranted. He has learned the value of the humble beginning and has clung to his resolution to manage his own affairs without outside help.

Just two years after he had taken his little boy to buy the promised radio set, at the

AT WORK AND AT PLAY—
Mr. Crosley tracing the intricacies of a blu e print in the shop office of his plant at Cincinnati. The circle shows the radio manufacturer and a very good friend, in a moment of repose

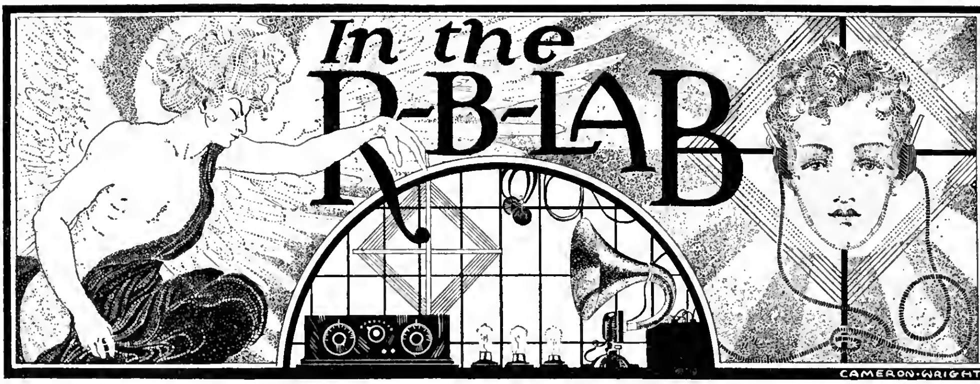
Precision Equipment Company, Powel Crosley bought out the concern.

"I worked out the details of the transaction at my sister's wedding and bought the company the next morning," he chuckles reminiscently. "When I'm figuring on some sort of deal, I can't put it out of my mind no matter how great the occasion. I believe in intensive work, however, and find you can accomplish much more by that means. Work hard while there's work to be done and then when the leisure comes, make the most of it.

"Any one can accomplish whatever he sets out to do. If he doesn't succeed at first, he will succeed eventually, provided he has ambitions and ideals and thrusts aside everything that interferes with his own progress."

SHOULD A CITY BROADCAST?

IS THERE a legitimate field for the city in broadcasting, or should that form of entertainment and instruction be left to commercial enterprise? James C. Young has prepared a highly readable article on the subject. He tells particularly what they are doing at WNYC, the new New York City station. It will appear in an early number



A MIDGET ONE-TUBE REFLEX

As THIS issue of Radio Broadcast reaches the hands of the reader, it is just one year ago that we published the original article on the building of the single-tube reflex receiver—the "Knock-Out." The passing year has seen the interest in this phenomenal receiver increase rather than wane, and while it is now essentially what it has always been—the finest one-tube set possible—suggestions from our readers and research in this laboratory have greatly increased the possibilities of the set. Almost every issue of In the R. B. Lab, since the article last November, has contained additional data on the construction and improved design of this receiver. The latest possibilities of the one-tube "Knock-Out" to be brought to our attention are embodied in the midget edition built by E. L. Faler, of Phoenix, Arizona, and are illustrated in the accompanying photographs.

The tuner unit is pictured in Figs. 1 and 2. This is primarily a vacation set. Compactness with the accompanying ease of transportation was the first consideration of Mr. Faler. With the not incorrect idea that portability of this receiver varies indirectly with the size, he has greatly compressed.

The over-all dimensions of the set are approximately those of the average cigar-box. In fact, the designer started out with the definite idea of confining the set to this size, and the cabinet might well be one of these boxes improved with a little sandpapering and stain. A second cabinet, of the same size, was provided to hold the batteries—flashlight A cells for the UV-199 tube, and four small block B batteries.

Fig. 2 shows the back-of-panel construction and gives a general idea of how compactness is achieved. The radio transformers, T1 and T2, are the Midget Harkness coils manufactured by the Phoenix Radio Laboratories. A Hedgehog audio frequency amplifying transformer takes the place of the usually rather bulky T3, and the flat Variodon condensers are substituted for the conventional interleaving plate variables. This last, however, is a rather doubtful innovation, as the air condensers are necessarily more efficient and desirable. The interested constructor is advised to employ the usual 15-plate variable condenser, which, with the judicious placing of the remaining parts, should not increase the over-all dimensions of the receiver. An Erla fixed crystal is used in the detecting circuit.

What the Lab Offers You This Month

—How to build a midget one-tube reflex receiver according to the famous Knock-Out design.

—How to wind tiny inductances for a cigar box receiver.

—How to install pilot lamps to record the filament lighting of tubes in de luxe equipment.

—Facts about resistance-coupled amplification with dry cell tubes.

—How to choose the right rheostat for your tube.

—How to build an ultra efficient inductance: a combination honeycomb and spider web coil.

—Suggestions for the amateur laboratory.

—Hints on radio construction and operating.

The hookup of the receiver will be found on page 497 of Radio Broadcast for April.

MAKING YOUR OWN MIDGET COILS

THE reader interested in building a midget one-tube reflex may very easily wind his own small-size inductances. Fig. 3 shows the coils manufactured by the Phoenix Radio Laboratories, while Fig. 4 illustrates an antenna coupler (T1) wound in this laboratory on a thread spool, which works very well in the single-tube circuit. Referring to the diagram shown on page 497 of Radio Broadcast for April, 1924, the following winding specifications hold for T1 and T2.

The average spool has a diameter of about three quarters of an inch and a winding surface of a little over one inch. Spools of these dimensions were used in the Radio Broadcast Laboratory. The secondaries of both transformers are wound with 112 turns of No. 32 enameled wire. The primary of T1 has 28 turns while that of T2 is wound with 65 turns. The primaries may be wound with slightly larger wire than are the secondaries, if desired. In our experiments, the primaries were wound first, followed by a layer of paper, and then the secondaries. As the secondaries take up practically all the winding space, the result is a little more neat than if the smaller windings are superimposed upon the larger. The leads from the primary are brought out through small holes in the winding surface of the spool, while the ends of the secondary are passed through holes in the sides.

If slightly larger spools are used, subtract two to five turns from the primary and secondary, and add them in case of a smaller spool. While these midget coils compare well in operation with the standard size, the latter are to be preferred when they are equally convenient.

RESISTANCE COUPLING AND DRY-CELL TUBES

THE growing and what we believe to be permanent popularity of the resistance-coupled amplifier has given rise to questions concerning the resistor and condenser values for different tubes, particularly in reference to the possibilities of the dry-cell bulbs.

Experiments in the R. B. Lab. indicate that the resistance-coupled audio amplifier can be used successfully with any amplifying tube on the market to-day. The dry-cell tubes function very nicely, and the resistor and condenser values are exactly the same as those recommended by Radio Broadcast for use with the UV–201–A. For the UV–201–A, the UV–199, the WD–12 (and the corresponding Cunningham and De Forest

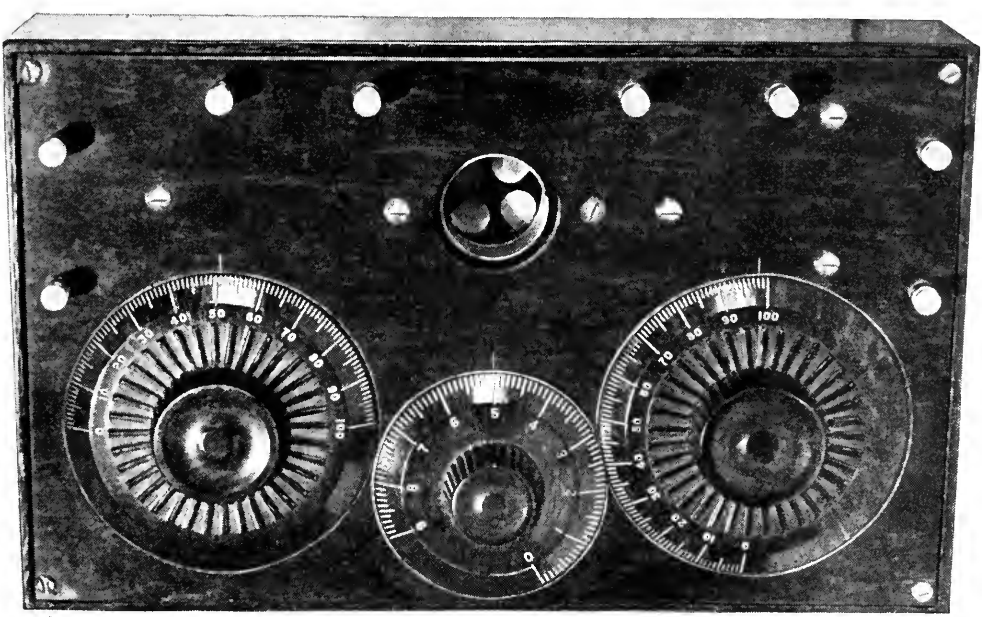


FIG. 1

The front of the midget receiver. The cabinet is the size of a cigar box

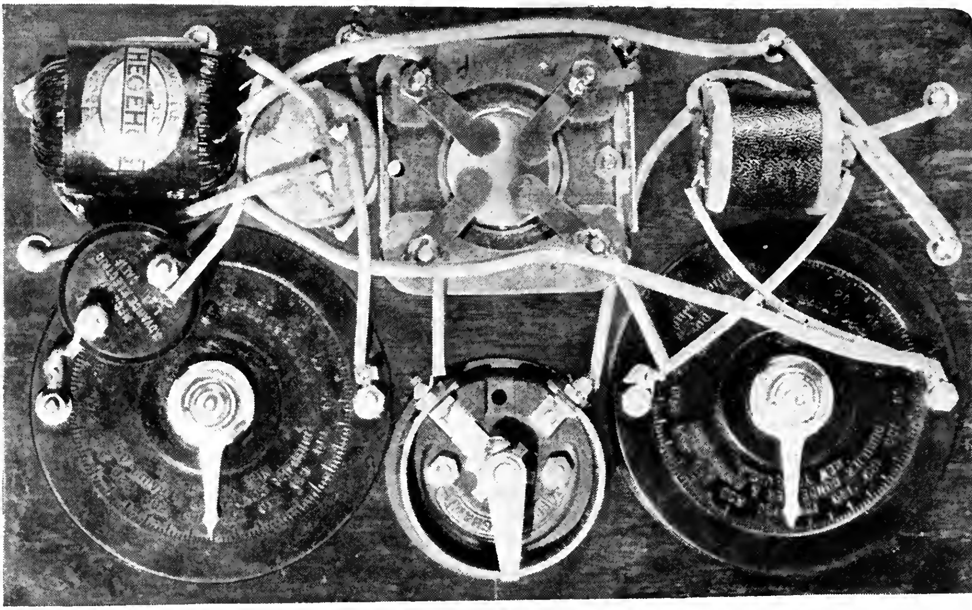


FIG. 2
Behind the panel. The compactness is achieved through use of midget transformers

bulbs), the Meyers tube (an exceptionally good amplifier for this circuit) and the Western Electric N tube, 100,000-ohm coupling resistors should be used in each stage. The isolating condensers are most conveniently .006 mfd. Micadons. The proper grid leaks, respectively in the first, second, and third stages are: 1,000,000 ohms, 250,000 ohms, and 50,000 ohms. The circuit for a three-stage resistance-coupled amplifier will be found on page 103 of Radio Broadcast for June.

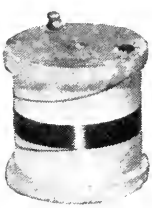


FIG. 3
A manufactured midget coil, for the Knock-Out reflex

None of the above mentioned tubes are recommended for a fourth stage, as the power handled will often exceed the capacity of the tube, with resulting distortion. A power tube, such as the Western Electric 216-A is suggested, using a coupling resistor of 100,000 ohms, a grid leak of the same value and a .006 mfd. isolating condenser. On distant and low-power stations, the UV-201-A will function satisfactorily in a fourth step. Excepting that a 50,000-ohm grid leak is recommended, the values are the same as those given for the UV-216-A.

Using the 216-A throughout the amplifier (a very fine arrangement) the values are the same as suggested for the lower-power tubes, excepting that the grid leaks for the first three steps should be 2,000,000 ohms, 500,000 ohms, and 100,000 ohms.

The plate voltages should be at least the maximum potential recommended by the manufacturer of the tube, which may be safely doubled with considerable increase in amplification. The plate resistors effect a drop in the battery potential.

SIGNAL LIGHTS ON DE-LUXE EQUIPMENT

THE day of exposed sockets or peepholes is fast disappearing, and fashionable radio sets (for engineers are actually bowing to *mode*) postulate completely enclosed bulbs. In many cases, lack of room for tube mounting in evenly spaced lines of visibility provides a more legitimate excuse for the hiding of the tubes. Such reasons, however, by no means obviate the desirability of knowing what tubes are burning, and in case of trouble of immediately either eliminating the A battery circuit as the source of

difficulty, or affirming that the trouble lies there.

Instant knowledge of filament circuit conditions is made artistically possible through the inclusion of signal lights in the set—small pilot lamps placed in the filament circuits and behind colored jewels on the front of the panel.

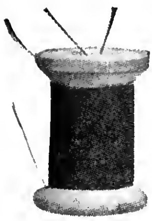


FIG. 4
A home-made small edition coil wound on a thread spool

There are two possible methods of connection—in parallel with the individual filaments, and in series with them. In the parallel arrangement the signal lamps are wired from the sockets—on the bulb side of the rheostats. The burning of the shunt bulb indicates the perfect condition of the A battery circuit *as far as the tube,* but does not necessarily mean that the bulb is lighted. Unless special lamps can be secured, this method is the better of the two.

Low amperage lights (that is, those which draw between $\frac{1}{4}$ and $\frac{1}{2}$ amperes) should be employed, having approximately the same voltage as the tube. Lower voltage lamps may be used in conjunction with small fixed resistances. Connected in this manner, the pilot lamps draw an additional current from the A battery—about one ampere for three indicators. This may or may not be a negligible disadvantage.

In the second or series connection, the pilot lamps are placed in series with each filament, being used as ballasts in place of rheostats which are completely eliminated. Connected in this manner, the extra lamps place no additional drain on the A battery, but operate on the energy which ordinarily would be dissipated as heat in a rheostat. The correct lights for this highly efficient arrangement should operate on the normal current of the tube and on a voltage equal to the voltage of the A battery, minus the operating voltage of the tube (the potential drop across the usual rheostat). Special ballast-indicating lamps for all popular tubes are being manufactured and are available to the fan in small quantities. If ordinary indicating bulbs are employed, the comparatively small potential drop through the filament of the cold tube, when the current is turned on, will place a disastrously high voltage on the pilot lamp.

This system indicates very definitely just what tubes are lighted. This function and the economical character of the arrangement recommend the series connection.

The lamps are screwed into special sockets that are easily made by breaking up the usual miniature porcelain base. The metal parts are salvaged, and the long terminal strip is bent over into a convenient bracket. Fig. 5 illustrates the manner of mounting the skeleton socket on the panel. The jewels, which can be obtained in a variety of colors from any manufacturer of switchboard supplies, are the smallest size, fitting tightly a $\frac{5}{16}$ inch hole in the panel.

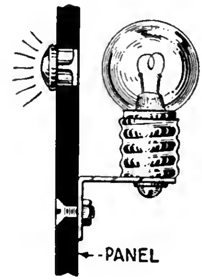


FIG. 5
How to mount the pilot lamps. All the necessary parts may be had by breaking up a miniature base

Figs. 6 and 7 show a resistance-coupled amplifier with automatic filament and amplification control in which pilot lamps have been incorporated. With the control switch in the middle, all lights are off. To the left, the output is switched to one stage of amplification, and the left-hand jewel flashes. With the switch to the right, all bulbs are lighted, the output is transferred to the last tube and the three jewels glow accordingly.

FIG. 6
Front view of an amplifier designed in the R. B. Lab. in which signal lights are incorporated

THE RIGHT RHEOSTAT

THE association of high-ohmage rheostats with the UV-199 and similar three-volt .06 ampere tubes, has given rise to a mistaken idea in regard to the proper resistances for dry-cell, quarter-ampere tubes. High-resistance rheostats, in the neighborhood of thirty ohms, are not required for the correct operation of such bulbs unless the battery voltage is considerably in excess of the operating potential of the tube.

A rheostat is included in the filament circuit to drop the battery potential to the operating voltage of the tube. It accomplishes this through a very fundamental electrical function—the voltage drop which necessarily takes place when a current passes through a resistance, and which is numerically equal to the resistance in ohms times the current in amperes.

The correct value of the rheostat for any tube is very easily determined. The best operating voltage of the bulb is always specified by the manufacturer. Subtract this from the voltage of the A battery from which

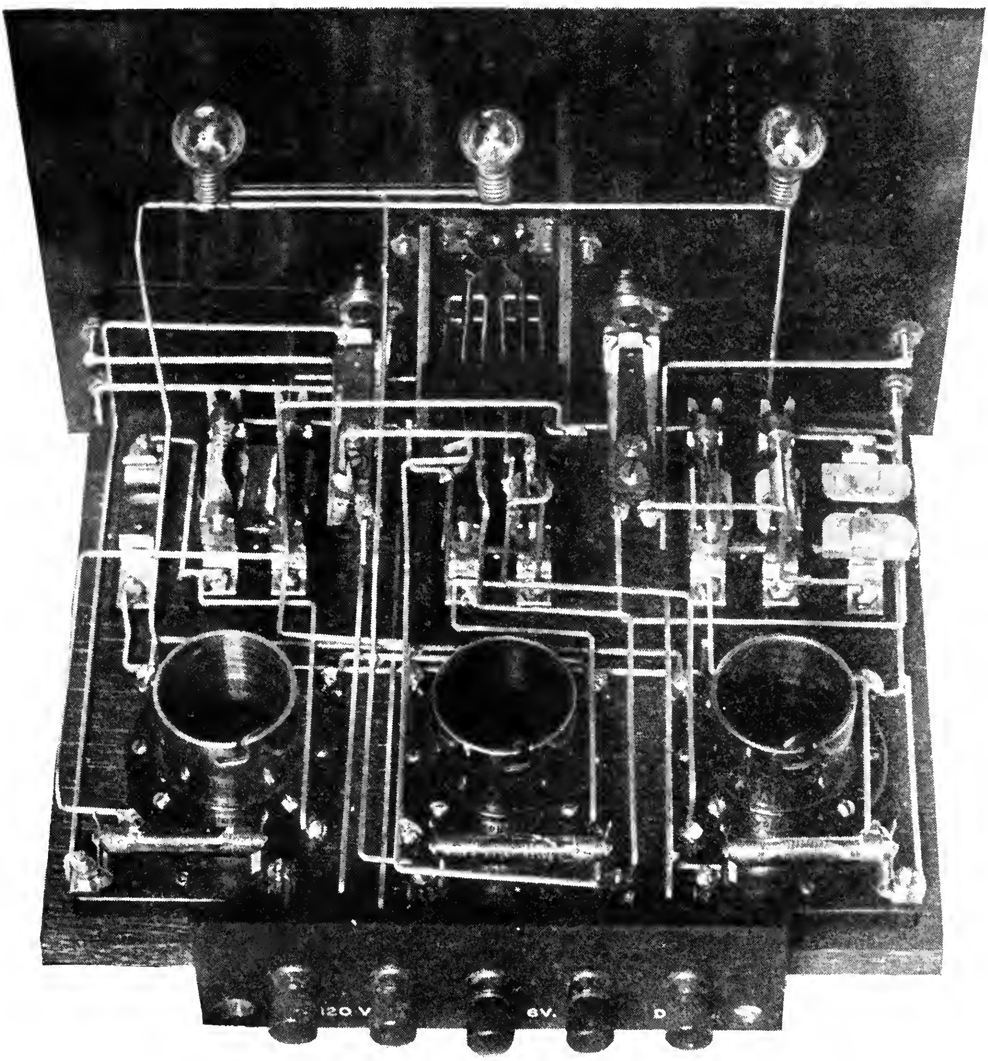


FIG. 7
Back view of the de luxe amplifier, showing method of mounting lamps. Parallel connection is used in this set

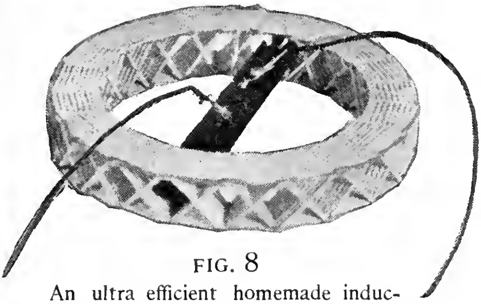


FIG. 8
An ultra efficient homemade inductance. It is easily made and will improve the operation of many sets

you will operate it. This gives you the required voltage drop. The current consumption of the tube in amperes, at the correct A-battery voltage, will also be found in the operating directions. Divide the required voltage drop by the current. The result is the minimum resistance that will permit the most efficient operation of your tube. For instance:

Operating a Cunningham C-301-A from a six-volt storage battery. The correct operating potential for this tube is five volts. $6-5=1$—the required voltage drop is one. The C-301-A is a quarter-ampere tube, therefore, $1 \div \frac{1}{4}=4$—i.e., at least four ohms should be used. Thus a six- or ten-ohm rheostat will be sufficient.

In cases where the adjustment of the filament temperature is at all critical (using the UV-201-A as a detector in regenerative circuits, for instance) the lower resistances will permit a finer variation of current.

The inter-relation of volts, amperes, and ohms, in regard to filament resistances and A batteries, will be found treated with especial regard to the principle of this very fundamental law in the October 1923 issue of RADIO BROADCAST.

A NEW-TYPE HOME-MADE INDUCTANCE

IN A recent issue of the Lab Department, we stated that the ideal inductance would be a self-supporting coil wound with uninsulated wire on air. Like many ideals, this arrangement is hardly practicable. Nevertheless, it can be approached, and in Fig. 8 we have what is probably the closest practical approach to this ideal condition, a coil wound by one of our readers, Mr. Horace A. Woodward, of New York City. The Sickles coil is a commercial form of this type of winding. It is essentially an exaggerated honeycomb.

The winding form is a disk of wood about three inches in diameter and three quarters of an inch wide. Into the periphery of the disk, one eighth inch from each edge, two rows of twenty-five evenly spaced pins are driven. Two-inch, No. 14 finishing nails are convenient for this purpose. Notches, which facilitate the last part of the work, should be cut between the pegs (Fig. 9) with a three-cornered file.

The coil is wound by passing the wire over two right-hand pins, diagonally across and over two left-hand pins as illustrated in Fig. 9. When the last turn is wound, the coil is sewn with a waxed thread and a flexible needle made of a short length of twisted wire. The needle is passed beneath the coil through the filed notches, taking the direction shown by the black thread in the photograph. If the experimenter prefers, collodion may be used as a binder and the sewing dispensed with, though this is theoretically inferior to the method employed by Mr. Woodward.

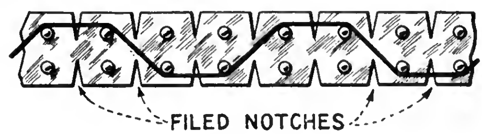


FIG. 9
The winding form for the low-capacity coil

The nails are finally removed and the coil slipped off. The inductance is self-supporting and will withstand an extraordinary amount of mechanical abuse. The ingenuity of the individual experimenter will suggest the most convenient manner of mounting.

These coils may be substituted for single-layer inductances in any circuit with probably an increase in efficiency. Mr. Woodward finds them decidedly superior to the spiderweb coils in the Roberts set. Assuming a three-inch diameter for the usual flat wound coils, the same number of turns on the improved inductance will give approximately the same wave range.

BUILDING YOUR OWN LAB

ONCE again we are rather prodigal, and for November we recommend two purchases to the owner of the growing lab—an automatic center punch and an adjustable square, shown in photographs Figs.

10 and 11. (These tools cost $1.44 and $1.05 respectively.

The center punch is an efficient substitute for the comparatively noisy and laborious older type on all materials but metal, and is from twice to three times as fast. The point is placed on the marking and the punch pressed down with the hand as far as the spring arrangement permits. This will result in a definite and satisfactory indentation.

FIG. 10
The automatic center punch. A speed tool

The square is an improvement over the ordinary fixed carpenter's tool. It consists of an accurate rule which is adjustable as to length, with readings in both directions on each side. An angular surface on the grip also permits the drawing of lines at an angle of 45 degrees to the straight edge.

Both tools are made by Starrett and add quickness and accuracy to the work of the radio builder.

HELPFUL HINTS ON BUILDING AND OPERATING

DON'T BLAME everything on static. There are many similar noises that are produced in your set. Disconnect your antenna. If the sounds stop, it is genuine static, and nothing, as yet, can be done about it. The nature of static and bona fide signals are so similar, and a static eliminator must necessarily also eliminate signals.

SHIELDING A RECEIVER is bad practice. It is only a pound of cure. It in no way affects the fundamental cause of capacity troubles, and it adds resistance to the circuit with resulting inefficiencies.

Mount tuning coils and inductances as far behind the panel as possible, and always connect the stationary plates of a variable condenser to the grid.

A properly designed receiver needs no shielding. (This does not apply to the individual shields about the intermediate stages in the super-heterodyne, though even here the successful elimination of the metal would probably be an improvement.)

IN CONSTRUCTING or designing radio apparatus endeavor to keep inductances and tuning coils away from the panel and necessary metal supports. Eliminate all metal work that can possibly be done away with. Precautions of this sort will add selectivity and sensitivity to the receiver.

NOT all bus wire is tinned. The real tinned bar is satisfactory for wiring purposes but very often nickel-plated wire is palmed off on the unsuspecting purchaser. This kind is not desirable since the nickel-plating increases the resistance of the circuit. Resistance is all right in its place—in rheostats and potentiometers—but otherwise it should be kept at a minimum.

THAT old, discarded three-cornered file may be resurrected and with a few changes will serve as a tool of many uses in the radio lab. On a grindstone remove all traces of the file ribs and sharpen the three edges to a keen knife-edge. Panel holes may be enlarged with this instrument or with a handle on both ends it will serve as a scraper to smooth the rough edges of panels.

NO MATTER what size holes are to be drilled in a panel, drill all with a small drill first—then enlarge with the proper size drill for the holes to be made. This results in evenly centered holes and will reduce the wear and tear on your larger drills. Put a flat block of wood underneath the panel to prevent the holes from chipping around the edges.

MANY of the binding posts now on the market are made of some sort of composition, easily affected by heat. Before soldering connections to a binding post, remove the top, or cover the entire post with a wet cloth. This will prevent the post from melting or otherwise losing its shape.

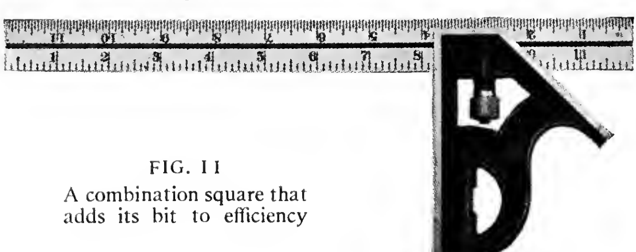


FIG. 11
A combination square that adds its bit to efficiency

AN OUNCE of prevention is worth a pound of cure, so follow the practice of the manufacturers and see that all socket nuts, transformer bolts, and other like parts are securely tightened before the units are permanently mounted in a set.

What News on the Radio Rialto?

Experiences Social, Radio, Mechanical, and General, of the Crew of Radio Broadcast's Covered Wagon, Direct from the Roadside

By CAPTAIN JACK IRWIN

ON A journey such as the Radio Broadcast Covered Wagon is making, it is difficult to confine oneself strictly to radio topics. The writer feels that his readers would rather read about some of the side-issues which can be counted as some of the most interesting features on a transcontinental tour such as ours.

Are we meeting with conditions that we anticipated? Yes and no. In the congested area surrounding Greater New York and extending beyond Philadelphia, we found the same happy, argumentative fans who rejoiced to meet us and swap stories of various circuits they had tried. We listened to variations on the same theme over and over again. In this area, practically the only source of complaint was of "blooping" receivers. Indeed, they have reason to complain. Throughout New Jersey and in the vicinity of Philadelphia, there was hardly an occasion upon which we set up our superheterodyne receiver that we did not have constant interference from radiating receivers. It was impressed upon us that the campaign against that type of interfering receiver which this magazine is making must be extended. Education in the use of non-radiating receivers, however lengthy a process it may be, is the only way eventually to eliminate this annoying source of trouble. A concerted educational campaign, together with close coöperation from manufacturers and reputable dealers would go far toward remedying the situation, which in the districts this Wagon has traversed are almost intolerable. Here is another method —an appeal to the better nature of the offenders. This fall and winter we will have innumerable radio shows and expositions throughout the United States. Those in charge of the exhibitions ought to make an effort to organize a campaign during the period of the radio exhibition season to bring the "blooper" users to see the error of their way. Again radio broadcasting stations could better conditions by periodically calling attention to the annoyance these sets cause to those in their vicinity. One thing this mobile laboratory has discovered is that nine tenths of those employing radiating receivers do not understand that they are offending and actually rail against their neighbors employing the same sets for interfering with their reception! We have endeavored, daily, to educate such innocent "bloopers" and point out that, if they are unable to change their receivers, they can at least so adjust their regenerative sets that a minimum of interference to their neighbors will result. Few, indeed, realize that the maximum amount of satisfactory regeneration is reached at the point just before the tube oscillates and that it is almost criminal, to allow persistent oscillation while searching for DX.

HOW THE LAUNDRY IS DONE

Captain Irwin spending part of a Sunday in necessary work. Earlier in the day from this camp in Pennsylvania, he listened to the services from St. Thomas' in New York. Dr. Stires preached on the subject "Cleanliness and Godliness Combined"

THE TRAIL WESTWARD

AFTER leaving the Metropolitan area of Philadelphia, we hit the Lincoln Highway directly on the trail westward. Beginning with Lancaster, Pennsylvania, we found radio folk were up against real hard luck.

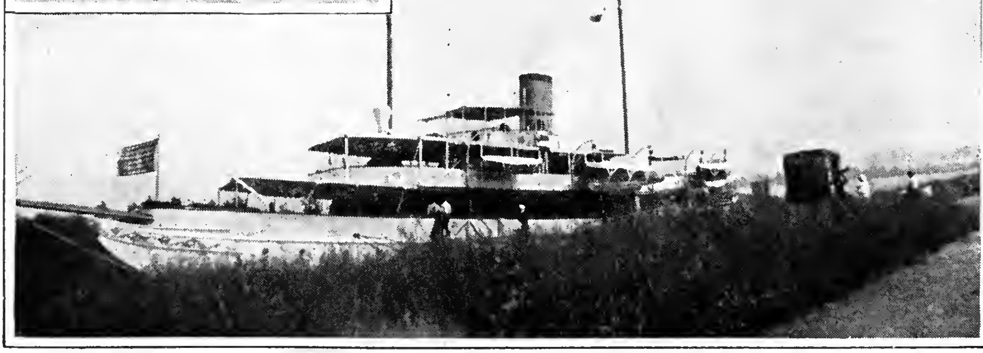
When we pulled in to the above mentioned city, almost the first fellow to greet us was a disgruntled fan who offered to buy our dinners if we could obtain results right where we were parked in the main thoroughfare of the town. Our eight-tube super-heterodyne was working like a charm. In other localities we dissipated the idea that such things as "dead spots," existed, we immediately took him up with the expectation of a good, free meal! A half hour later this fan went on his way, chuckling at us. We found the greatest source of "man-made" static we had ever heard. It was impossible to diagnose the cause, it was just one jumble of discordant noises which made the air crackle hideously. We learned later that this condition was general in the business and downtown residential districts of the city. The lighting and power plant is an ancient one with all overhead conductors. The only source of comfort the resident fans of this perturbed district have, is the rumor that the plant is to be modernized with underground conductors distributing both light and power. One enthusiastic experimenter had just graduated from a crystal receiver, to a six-tube super-heterodyne for which he spent several hundred dollars. He complained to the writer of the extraneous noises he had obtained, totally obliterating good strong radio signals. Another friendly fan had erroneously diagnosed his trouble as B battery faults, but the writer upon investigation discovered the noise to be nothing else than the old "man-made" static. His set was in perfect order, but the conditions surrounding his residence made it impossible to obtain the satisfaction that he should have with his excellent receiver. Such are the conditions that the good radio users of Lancaster and Harrisburg are up against. The same is practically true for the adjacent smaller towns.

RADIO AND REAL ESTATE VALUES

WHILE pursuing this line of investigation in Pennsylvania, I learned to what influence faulty generators and power conductors had when leasing or selling real estate was considered. While parked in a quiet neighborhood in one of the larger cities, a gentleman approached the WAGON and asked how the reception was in that particular vicinity. Upon learning that it was fairly good and freer from interference than in other localities in which we had demonstrated in the same city, he expressed gratification. It appeared that he was the real estate operator handling property in that district and that prospective buyers or lessees invariably asked if radio reception was good in that neighborhood. It transpired that "man-made" static was so prevalent in the town that real estate values were affected. This gentleman assured us

HENRY FORD'S SEA GOING YACHT

The trim *Sialia* and the COVERED WAGON. A special berth at River Rouge, Michigan, near the great Ford plants at Dearborn and River Rouge is used for the yacht which, by the way, is completely equipped for radio telephone and telegraph. Her call is WSY. A group of her crew are inspecting the radio equipment of the WAGON



A WAYSIDE CAMP

Of the COVERED WAGON and its crew of two. George A. Eckweiler, Captain Irwin's assistant, is in the foreground, behind an old Pennsylvania tree

that it was not an isolated inquiry from a particularly enthusiastic fan, but that such inquiries were very frequent. He thought probably the same inquiries were made in every community. I had to confess that his was the first case of which I had heard when the fate of a piece of property depended upon radio conditions. This example illustrates what poor conditions exist in certain communities for broadcast reception. The elimination of the causes of "man-made" static will be compulsory once the pocketbook of property owners is affected.

THE INTERFERING CASH REGISTER

PURSUING the hunt for unnecessary interference in a certain western Pennsylvania city we ran across an amusing case, but nevertheless a serious one from the point of view of the man with the receiver. Discussing the cause of interference in this particular spot with a nearby resident, he explained that he had no cause for complaint except one. It seemed that he was the fortunate possessor of a well-known make of super-heterodyne receiver which gave him excellent results until the man in the store under him installed a new cash register operated by a small electric motor. Since that time his satisfaction and contentment had disappeared as he now listened to radio signals interspersed with the ringing up of sales on his neighbor's cash register. He further explained that the busiest time appeared to be when the best features of the various programs happened to be "on the air." However, he added that his interfering friend closed before DX came on!

TOURISTS AND PORTABLE SETS

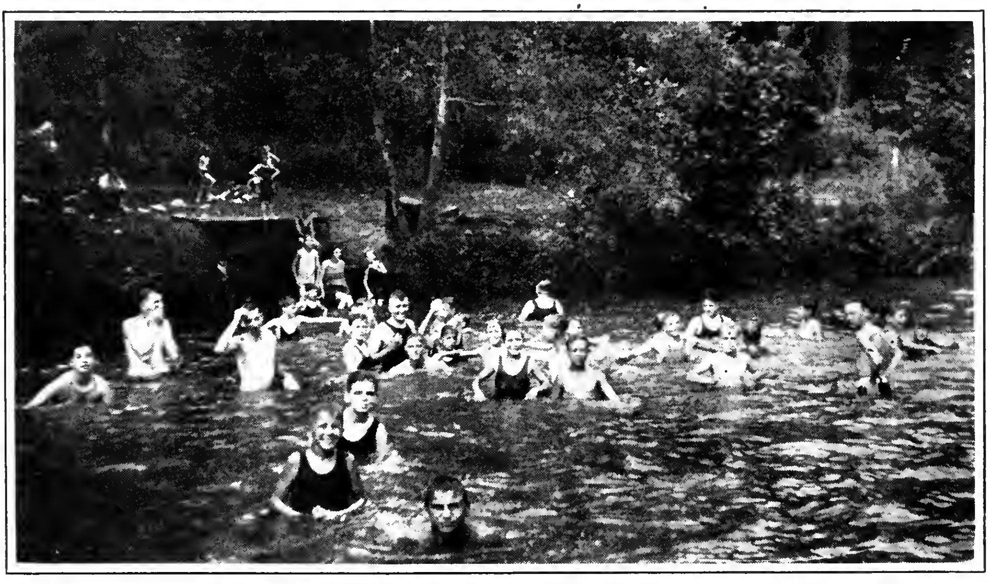
SPEAKING with several of my friends who are radio dealers in New York, I gathered that the sale of sets for portable use had received a decided boost this summer. This was further borne out by the large amount of space devoted to these sets in both the newspaper radio columns and in magazines. I have camped with hundreds of well equipped automobilists who are touring the continent, and to date have found but one carrying a radio outfit, and that a simple crystal unit carried by a boy in a party. If many portable sets are in existence, it would seem that they are carried to more or less permanent camps and that the strictly auto camper has no use, or perhaps, space, on his overloaded car for what he may regard as a luxury. For this reason, the advent of RADIO BROADCAST'S Traveling Laboratory into a camp peopled with tourists is always a welcome event. They are astounded at the results obtained from a mobile station and with the apparent ease with which loud, clear signals are obtained without the use of antenna or ground,

Many a comment I have heard that "next year we must carry a radio." We are besieged with visitors, often to such an extent that it becomes embarrassing. Imagine, for instance, when you are changing into your other shirt, the flap of the wagon will be swept aside and a delightful, cheery voice ask, "Say, Mister, how about a little jazz!" But seriously, I have found that the possession of a radio outfit in good working order induces a wonderful friendliness from your fellow campers in quiet spots. The owner of a radio set in a tourist camp attracts much attention and is the means of meeting some intensely interesting people from all over the country.

AND WE HAVE OUR TROUBLES

MANY of my friends have assumed, after visiting the COVERED WAGON, that it is a mission devoid of trouble. Is there a man in the radio game who can truthfully say that he can manipulate six different receivers, in turn, and not run against seemingly inexplicable faults in one set or another? Add to those six sets, a housing on four wheels propelled over more or less rough roads, and your radio troubles will correspondingly increase. During the earlier stages of our journey, we were comparatively free from such annoyances, due, of course, to the smooth roads of closely populated areas. During that period we had no hesitation in coupling up one of our sets and expecting instant results. However, as our journey progressed, we found the road shocks increased and, correspondingly, our radio faults occurred more frequently.

An old friend of mine always insisted that a "law of cussedness" existed! I can assure him, if these columns meet his eye, that undoubtedly he is correct. Our experience would indicate a most pronounced law of that discription. Now we never attempt to display our wares in public without first staging a rehearsal in some secluded spot in order first to ascertain how much damage bumps and ruts have caused *en route*. Our instrument tables are slung upon springs. An abundance of sponge rubber is employed to resist road shocks, nevertheless, a broken inaccessible connection is very frequent. Invariably this occurs at the most inopportune time. An instance of this inopportunity recently occurred when we were the guests of the Kiwanis Club of a certain city. This club maintains a camp for boys in a most delightful spot in their attractive city park. We had been accorded the hospitality of the camp and the privileges of the "old swimmin' 'ole." At noon I had given, by request, a talk to the boys and concluded with a promise that we would entertain them with a radio concert that night at our camp.



THE WAY A RADIO LECTURE ENDED

Captain Irwin and a group of the sons of members of a Kiwanis Club of an Eastern city in swimming. The boys had previously shown much interest in the radio equipment aboard the WAGON and Captain Irwin told them about it, and some of his interesting experiences "in the old days" of wireless

AT DETROIT

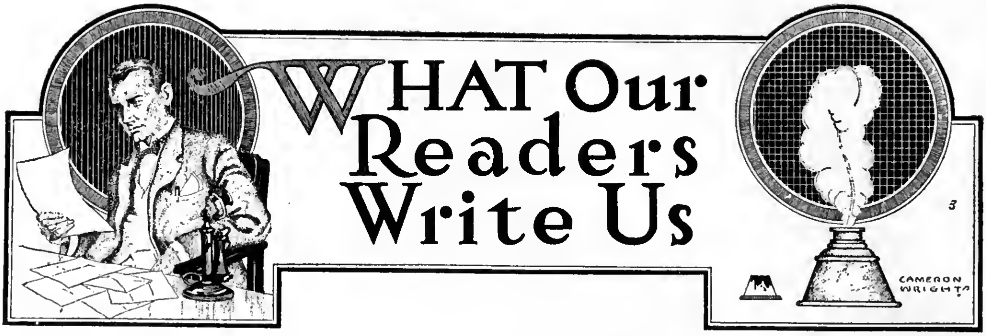
The WAGON parked alongside the Detroit River during the time the September motor boat cup races were held. Progress of the event was followed by a broadcaster in a motor boat. Captain Irwin took part in the announcing

"TROT OUT YOUR RADIO"

AT THE appointed time a half hundred real, healthy young Americans descended upon us and with lusty cries demanded that we "trot out our radio." Anybody who has had much acquaintance with youth ranging from ten to fifteen years of age will surely sympathize with us when I confess that the alleged expertness of both Mr. Eckweiler, who accompanies me, and myself, failed to make that set "perk"! There is no more critical audience in this world than a bunch of American youngsters. On this occasion, the inexplicable part of the trouble was that there was no apparent fault and after the boys had departed and retired to bed, the set suddenly decided to work wonderfully. To make matters worse, the following night found us in the same camp with the worst static storm I have heard in progress. Do you think that group of boys believed our old static alibi? But there isn't much need of answering this question.

EPILOGUE AND EPISODE

NOR are all our troubles on this expedition radio ones. Of course tire troubles are to be expected. But who would look for a punctured tire caused by a gramophone needle on top of Mount Tuscarora? Yet that is what we experienced. Some misguided tourist had taken a phonograph along instead of a radio receiver and cast the discarded needle directly in our path! Another amusing episode not connected with the radio side of our journey was caused by an innocent enough appearing bug called the Japanese Beetle. It is not so innocent as it appears. The Department of Agriculture lists it as one of the most destructive pests ever to find its way into our fields. Just after leaving Philadelphia we were stopped on the highway by state police who began to search our wagon. I facetiously remarked "We haven't a drop in the house" thinking they were searching for prohibited beverages! To my huge surprise they confiscated all our vegetables which we had stocked a few miles back at a ridiculously low price! We were then allowed to proceed, but only a few hundred yards further on was a well stocked vegetable stand, doing a land office business! Nobody can convince the crew of this wagon that that stand is not run by the Pennsylvania State Police! That night a stray dog stole our supply of ham. Yes—life on the COVERED WAGON is great!



WHAT Our Readers Write Us

A Marvel in a World of Marvels

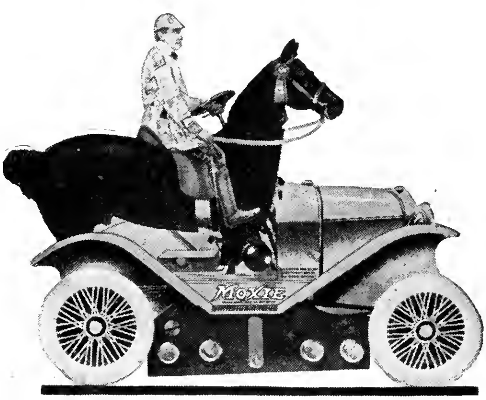
NEW receivers and new equipment of all sorts and descriptions come piling into the office every day, but the technical and editorial staff was greeted the other day by an incoming piece of "new equipment," the like of which had never before been seen. We have seen many designs of portable receivers, but never before has any swimmed into our ken which combined the features of the horse age, the automobile age, and the radio age. The accompanying letter and photograph tell the story better, it is quite certain, than any of these rather breathless words here.

Editor, RADIO BROADCAST,
Doubleday, Page & Company,
Garden City, L. I.
DEAR SIR:

Confident, as you are, that the millenium had been reached when you announced your "Knock Out" series, we are keenly desirous of taking the puff out of your sales by presenting to you herewith one of our MOXIE DX RADIO RECEIVERS. Designed for us by the Hunchback of Neutrodyne, it represents a life's endeavors among the many closed doors in the realm of science. It is very much more than a toy. It is an electrical instrument calculated to satisfy the demands of the most critical brass pounder and yet ornamental enough to minimize, if not to prevent entirely, the "*re*-radiation" of the whiniest kind of wife. This little MOXIE DX RECEIVER is a veritable globe-trotter, too. We can, if pressed, produce a certified letter testifying to the reception of 2LO via Pekin, China. Our little set is daily causing the users of supers to abandon the Christmas tree type of tuner for ours. We do not desire to upset a struggling industry, however, and do not wish to have our circuit published. For quality of reproduction the MOXIE DX RECEIVER is unsurpassed. The crystal used is a chip from one of the priceless toe rings of old King Tutankhamen. Major White at the ringside comes in like Mozart's 666th overture. We regret exceedingly that we cannot place one in the hands of Zeh Bouck before he sails to Europe, for our receiver is especially efficient on water. If you can induce him to design resistance-coupled radio-frequency and audio-frequency amplifying circuits for it, we are confident that you will be able to announce another "Knock Out" before Christmas. Seriously, though, try your antenna circuit with this little gem. You are in for a continuous series of surprises.

Yours very truly,
The Moxie Company
F. B. Walker, New York.

P. S. The writer wishes to take this opportunity to include his check for $5.00 in payment of a subscription for RADIO BROADCAST. It may interest you to know that he is doing so largely because of Zeh Bouck's barrage attack on the advertisers and users of one-tube squealers.



THE RECEIVER ON WHEELS
Complete without reservation, what with horse, driver, rubber tires, binding posts to match and a shiny crystal

What are the Ethics of Radio?

IN THE "March of Radio" for July appeared an editorial about a New York church which broadcast a Holy Communion

service. At the time, in New York, there was a considerable amount of criticism. The writer of the letter printed below takes exception to the editorial, which he thought was directed against the broadcasting of church services. As a matter of fact, the editorial deplored the broadcasting of the Communion service and questioned the advisability of sending this most sacred ceremony of the church into the air. Church broadcasting itself seems to be thoroughly established, for even in the early days, KDKA, the first broadcasting station to go on the air, in the sense that we now think of broadcasting stations, sent out the services of a certain Pittsburgh church. It is a new art, radio, as has often been observed, and its ethics are slowly being developed.

Editor, RADIO BROADCAST,
Doubleday, Page & Company,
Garden City, L. I.
DEAR SIR:

I read the announcement of your $500 Prize Contest, "Who Is to Pay for Broadcasting?", in the July RADIO BROADCAST.

Well, who pays for anything? Who pays for the double page ads, in the daily papers and magazines that cost thousands of dollars for a single insertion? Radio is simply the latest method of advertising, as your article "Holy Communion By Radio" on page 221 of

Columbus, Ohio, ...192......

....

Radio Station ....

....

Gentlemen:-
Your programme .... between the hours of ....and ....M. Eastern Standard Time was received by me on my Radiola Super-Heterodyne. It came in .... and I especially enjoyed ....

....

....

I thank both you and the artists.

THE COLUMBUS SLATE CO.,
WHOLESALE ROOFING SLATE
16 E. Broad St., Columbus, O.

H. W. WEBB,
233 Preston Road,
Columbus, Ohio.

AN APPLAUSE CARD OF GOOD DESIGN

the same issue admits. The buying public pays, of course, and always has paid, or the advertiser goes out of business. Why should there be any objection to church advertising?

At the end of the editorial mentioned, I find, "At the risk of being called old fashioned and out of date, we venture the opinion that this minister did the Church a dis-service by distributing his Communion service, his most precious possession, in places where it wasn't welcome."

Wrong! You cannot force radio where it is not welcome. A twist of the wrist and it is gone. I catch my news or music just the same while church services are going on. Such services are no bother to any one who does not wish them. You sit back in your comfortable steam-heated apartment and take life easy. Consider those who are not so fortunate, those who are miles from any means of transportation, who haven't even a flivver, and if they have one, the roads are so bad that they dread a trip over them. These folk may have their little radio set and can enjoy their religious services, if they are welcome, or jazz, as their wills dictate. After all, it is a matter of opinion.

G. K., San Francisco, California.

Another Applause Card Design

ALL radio listeners are by no means as lethargic as some of the distressed program managers of broadcasting stations would have us believe. One of the best reasons for this conviction is the increasing number of listeners who are having their own applause cards printed. Perhaps the broadcast listeners have taken a leaf from the well-filled book of the amateurs who have long been in the habit of sending each other printed cards announcing that the station of the recipient had been heard. At any rate, the writer of this letter sent us one of the cards he sends to broadcasters who please him. His design may suggest a similar one to other listeners.

Editor, RADIO BROADCAST
Doubleday, Page & Company,
Garden City, L. I.
DEAR SIR:

A recent letter in "What Our Readers Write Us" on applause cards has made me think that the least we of the listening class could do is to write the broadcasting stations in appreciation.

I have made a form, as per copy inclosed, and have had them printed on postal cards. I keep them on my radio table to use when anything extra good comes in.

If enough listeners will do the same, it may give the broadcasters and artists the proper encouragement.

H. W., Columbus, Ohio.

Who Was the First to Broadcast?

EVERY once in a while the discussion starts about who was the first to broadcast. Mr. Cannon's letter raises a point which should interest other experimenters who were carrying on wireless telephone tests about the same time as he was. We suggest that those who are interested write Mr. Cannon directly. Without entering into the discussion our-

selves, it is interesting to recall that Dr. Lee De Forest was carrying on experiments with wireless telephony from a studio at 103 Park Avenue, New York, in the spring of 1908, when he broadcast "Cavaleria Rusticana" from the stage of the Metropolitan Opera House.

Editor, Radio Broadcast
Doubleday, Page & Company,
Garden City, L. I.
Dear Sir:

One hears off and on quite a bit of discussion as to who really ran, in a practical manner, the first broadcasting transmitter.

This interests me, as I have quite an inclination to believe that this station handled the first phone of this type. During the months of December, 1916, and January and February, 1917, I ran quite a regular schedule from 9:30 p. m. to 10:30 p. m. Press was broadcast. Phonograph records were sent out and several instrumental artists contributed.

The range of transmission was about two hundred miles maximum. The modulation compared very favorably with that of the stations of to-day. There were only about a dozen special tubes in existence I believe, and the ones I used would now be rated at about fifty watts. Our efficiency was low, naturally.

I have numerous documents to prove the above contention and wonder just where my station ranks among the first of broadcasters.

George C. Cannon,
Radio Station 2ZK
183 Drake Avenue,
New Rochelle, New York

Captain Irwin and the "America"

Editor, Radio Broadcast
Doubleday, Page & Company,
Garden City, L. I.
Dear Sir:

I was interested in Jack Irwin's article "At Sea with the *America*." It recalled some pleasant memories to me. Just a short time before the *America* sailed, I was down at Atlantic City and rebuilt the United Wireless radio station on the Million Dollar Pier. Operator Miller, whom Irwin mentions, was at that time assistant operator. It is a far cry from those days to Radio of to-day. When one considers the few stations at that time and the difficulty of getting through the New York radio traffic jam from a vessel at sea, the change is marvellous. I have several times come up on a coastwise steamer and seen the operator try to get his stuff through and finally deliver it by personally taking it to the office when the ship docked. In those early days when a fellow wanted some wireless material, he had to make it. However, I remember getting New York regularly at Sterling, New Jersey, thirty miles from the city, with a paper-tube inductance, a carborundum detector, and an 80 ohm standard phone receiver. What a splash a Roberts circuit would have made in those days!

A. A. Weiss, Copperhill, Tennessee.

Radio Comes to Tennessee

Editor, Radio Broadcast,
Doubleday, Page & Co.,
Garden City, L. I.
Dear Sir:

I think from the first time I ever heard of a radio I was interested and anxious to own one. But not so with my husband. He felt that it would be money wasted. After some talking, I finally persuaded him to buy third interest in a community radio which we could keep only a third of the time.

We missed the set so much when the other partners had it that finally we had a discussion at home as to whether or not we could afford to buy one right then and there. However, all my arguments were settled speedily when one night we heard Daniel Macon, that great banjo player who is known all over the country, as the Dixie Dew Drop. He is an old friend of ours, but we had lost account of him for a few months. We bought a new radio at once and, needless to say, we have enjoyed hearing Uncle Daniel playing through our listening-in to him, almost as much as we did when he was in our own home.

It is impossible to tell the pleasure the radio has given us. There are only six radios in our area of thirty square miles. So quite often, we invite our friends in to enjoy a good program of music or lecture of some special interest. The weather forecasts were broadcast last spring when almost everyone around had large numbers of little chickens. If there was to be bad weather, I would call to my nearest neighbors and telephone the others. In that way, we could get our chickens up and saved much work and worry.

We have a friend who cannot walk and who hasn't been outside her own home for two years. Every few Sundays, we carry our set to her home. The only way she can hear a Church service is when we bring our set to her. She says that it seems like Church in her own home, not only are the sermons splendid, but we get such beautiful singing. They are mostly old sacred songs that we all know and love.

My son is only five, but he never retires until nine o'clock when we get the chimes playing "Old Kentucky Home" from Louisville. They never grow old.

Mrs. W. H. T.,
Christiana, Tenn.

The Importance of the Radio Amateur

The High Place the Experimental Operator Occupies—How High and Low Alike Have Each Contributed Their Share to Radio Development

By Dr. W. H. ECCLES, F. R. S.

I MIGHT remind you of what you all know, that the Radio Society of Great Britain exists for the benefit of those who practise or study wireless for its own sake, whether or not they happen to make any money by part of their work in the subject. Meetings are held for the inter-communication of scientific information, for mutual instruction and assistance, for bringing together people interested in wireless, and for the circulation of ideas of all sorts by all feasible means. During the last few years the influence of the Society has rapidly extended as the result of the enormous growth of public interest in wireless, and also as a result of the policy of affiliating societies scattered throughout the country; and thus the Radio Society has found itself becoming, almost in spite of itself, the center of the amateur movement of the whole country. Therefore, in addition to the functions which I have just enumerated, the Society is confronted with the task of holding the amateur movement together in the most difficult times this movement has yet experienced. It is also faced with the task of watching political and other circumstances that are likely to react upon the amateur. Almost simultaneously with these duties there came the need for taking over the management of an ambitious program of work projected by the British Wireless Relay League and for helping the inauguration of the Schools movement. The former piece of work was separated as the Transmitter and Relay Section, and the latter has become the Schools Radio Society and holds the rank of a section of the Society as defined by the new rules. Both these new burdens on the Society are nation wide in their scope, and meet needs that were strongly felt.

In carrying out these tasks, the Society finds itself in the midst of two great popular currents which affect its future very deeply. First, there is the increasing use of wireless for public and commercial message services and for the distribution of entertainment by the broadcast. The latter, of course, is a newcomer, and yet it overwhelms the older use enormously. Besides this, there is the increased public interest in wireless science chiefly as the result of the arrival of the broadcast. The former current is making the spectrum of usable wavelengths more and more tightly packed, leaving less room for each user, including the amateur. The second current, *i.e.*, the increasing popular interest in wireless generally, is bringing more and more persons into the ranks of the student and the experimenter. Many a holder of a constructor's license is turning his attention to a study of the subject and is already a recruit, of greater or less merit as the case may be, to the ranks of the amateurs. Thus we have the rather unpleasant result that there are more amateurs than ever before, and they have to be accommodated inside a narrower region of

Fishing in the Electrical Ocean

Some one is going to write a fascinating story some day, and it is going to be called "The Romance of the Radio Amateur." The realm of wireless has from the very beginning been explored by enthusiastic, deadly earnest, and often, very gifted persons who were held in it much more from the love of it than because of any mere money they might gain. As Dr. Eccles points out in this very interesting article, which by the way, was an address to the Radio Society of Great Britain, "A man cannot always explain to you why he keeps rabbits." No more can the wireless amateur tell you why he loves the art. Dr. Eccles is a well-known and respected English scientist and his story will be read with interest by broadcast listener and confirmed amateur alike. And, to misquote Kipling, all radio amateurs, no matter in what country they live, "Are sisters under the skin."—THE EDITOR.

the spectrum than would have been available before.

TWO BIG PROBLEMS

IT SEEMS to me that in consequence of these new circumstances, there are two big problems immediately in front of the Society. One is to ensure that the amateur and student of wireless telegraphy obtains his rightful share of the spectrum in accordance with his relative importance among all the other users of wireless. The other big job for the Society is to help in the establishment of order among the users of wavelengths appropriated to the amateur transmitters and the broadcast listeners. Regarding the rights of amateurs to bands of wavelengths, there are many people, I believe, who say that amateurs have no right at all to any wavelengths, presumably because they are not making money out of it. Ours is a nation of shopkeepers, and this attitude of mind is to be expected from such a nation, but it is the duty of this Society to show the nation that the work of the experimenter is worthy of encouragement from the point of view of the long-sighted shopkeeper and the industrialist.

THE TWO TYPES OF WIRELESS AMATEUR

THERE are two main types, it seems to me, of wireless amateur. First, there is the man who wants to construct apparatus and see it work; and, secondly, there is the man who wants to experiment in and practise the art of communication by wireless. The first type of man is at home with many other mechanical and electrical hobbies, and I addressed this Society last autumn in the endeavor to show that he was, in virtue of his hobby, a very useful member of the community. The second type of amateur follows his hobby because he simply dotes upon the doing of it. He cannot explain his affection for it any more than another man can explain why he keeps rabbits, for instance, or still another man explain why he goes fishing. I confess that I myself cannot conceive why anybody does either of these latter things unless it be that the men in question consider rabbits or fish to be delectable articles of food. I am always particularly perplexed by the angler, though I respect his, to me, unfathomable motives; but I think I can sympathize with and understand the passion of the wireless amateur who goes fishing in the electrical ocean, hoping to draw a congenial spirit out of the unknown depths. This type of amateur sits in his laboratory and sends out a little message, baited with 10 watts, say, and then listens with beating heart for a response from the void. Usually his cry is in vain. He draws a blank. But sometimes he hears, mixed up with his heart throbs, a reply from another "brass pounder" calling him by his sign letters. What a thrill! And when the response is faint and seems to come from very far away, with what excitement does he struggle to maintain touch? I can imagine the anxiety and enthusiasm with which he deciphers the Morse, say, of an American amateur, is overpowering; and I can imagine the despair with which he battles against the demons of fading and interference. I can feel it is a very exciting and thrilling sport, but it is more than that. It teaches a wonderful skill in manipulation, and it screws up the efficiency of the apparatus and the man to the highest pitch. The DX man, striving to get across enormous distances with minute power, becomes far more expert than the professional operator.

AMATEURS AND THE WAR

I REMEMBER very well that men of this type altered the whole standard of transatlantic reception during the War. After the United States came into the War the receiving stations on the Atlantic coast, particularly the large station at Otter Cliffs, which many of you have heard of, were manned by young fellows practised in DX work. They succeeded marvelously, and read a record number of words per day. At that time Lyons was enlarged by the addition of a bigger arc, and Bordeaux, just after the close of the War, was brought into operation with another arc, and these men succeeded so marvelously in receiving the messages transmitted that the Government experts of the United States came to the conclusion, and announced very emphatically, that at last the Atlantic was conquered, and that it was possible to ensure a regular uninterrupted twenty-four hour service per-day in summer and winter, without delays, by the aid of such transmitting stations as the arc station at Lyons. Then came demobilization and the DX men went home from the Atlantic coast. Their phones were picked up by the orthodox operators, the standard of reception fell immediately, and so, as far as I know, has not yet risen to its former glory. It will not, I think, rise to the same height with the same apparatus again.

THE IMPORTANCE OF DX WORK

AS ANOTHER example of the utility of this DX work, consider the recent results achieved by a small band of private workers

who, during the last month or two, have been trying to find lanes under the Heaviside layer, across the Atlantic. You all know the success which has been attained with short wave-lengths throughout an unexpected number of hours in the twenty-four. I do not doubt that if these amateurs had left the problem alone we should to-day be ignorant of its possibility. It might have been many years before these facts would have been revealed in the ordinary course of things. The feat is not an easy one, as is shown by the fact that if they could have done it, some of the commercial wireless companies would certainly have made very profitable advertisement out of it. Moreover, the governments on both sides of the Atlantic maintain large staffs of men, some of whom have very little more to do than listen in to signals. I am thinking of the naval and military and air forces particularly, in France, in America, and in this country. These facts escaped their notice and, indeed, would have been regarded as incredible.

From all this I deduce that in wireless, as in many other pursuits requiring concentration and skill, the best results are often achieved by men who are not brought up to work at it for a living. This holds good in yachting, in cricket, in marksmanship and many other sports. It holds still further, in my opinion, in the sciences and in the applications of science; and especially in the scientific hobbies, including, of course, amateur wireless, which, in addition to its fascination as a sport, possesses also the qualities of immediate importance in commerce and of utility in national emergency. It is quite conceivable that these discoveries of the properties of short waves may be of great commercial service, and certainly might be of immense military significance in time of war.

The last time I addressed you—last autumn—I paid most attention to the merits of the class of wireless amateur who is fond of his hobby because he can make and work something, and I tried to show you that he deserved the support of every intelligent citizen, and certainly of this Society, which is largely constituted of him and by him. I said nothing of this other kind of man, however, partly because there was no time, and partly because it did not occur to me that such remarkable results could be achieved by him in the immediate future. I am therefore specializing on this other type of wireless man to-night in the hope of showing you that the "fisherman" type, if I may call him so, is worthy of his salt, worthy of our support and encouragement, and merits the granting of every possible facility that we can find for him.

> **The Importance of the Radio Amateur**
>
> ". . . I can imagine the anxiety and enthusiasm with which he deciphers the Morse, let us say, of an American amateur, is overpowering, and I can imagine the despair with which he battled against the demons of fading and interference. I can feel it is an exciting and thrilling sport, but it is more than that. It teaches a wonderful skill in manipulation, and it screws up the efficiency of the apparatus and the man to the highest pitch. The DX man, striving to get across enormous distances with minute power, becomes far more expert than the professional operator. . . ."

INEXPERIENCED AMATEURS

I HAVE been speaking so far—both last autumn and this evening—of the best of the amateurs who form, I believe, the larger portion of the membership of this Society and the Affiliated Societies. But there are others, and many of these lack skill and produce considerable interference with military and naval services and sometimes with broadcasting services. Amongst these must be included the kind of amateur who uses 20 or 30 watts to establish communication between himself and a friend a mile away, and thereby agonizes everyone within 20 miles. Then there is the amateur who blares forth, without provocation or excuse, recitatives from corrugated gramophone discs; there is the amateur who never listens in either before or after shooting his bolt; there is the man who specializes in apparatus comprising every possible error of design and who emits the broadest possible band of waves. Perhaps many of these sinners know not what they do; others there are who do know, I think, what they are doing, and do it almost, one might say, of malice aforethought. Many of this class have no call sign, and others use fancy call signs, and there are others, again, who use other people's call signs, a tribe that is quite unlicensed. Besides these there are other nuisances, but I am going to refer to them a little later in another category.

The state of affairs represented by what I have just said appears to be getting worse

rather than better. You will remember that we formed last autumn a Transmitter and Relay Section, and that we gradually built up a scheme of relay work in different parts of the country. The almost inevitable result of the attempts to get relay chains working was a crop of reports that so-and-so was washed out by somebody else breaking in on the same wavelength with some gramophone tune or something of that kind; or that somebody had been interrupted by a person using his own call sign illegitimately. The state of affairs, as I say, seems to be getting worse rather than better. There are three parties interested in this matter. There is the amateur who wants to do his work in a reasonable manner; there is the broadcast listener who is very often on the same waveband as these interrupters; and then, last but not least, there are those who are using wireless for transmitting messages on government service or for commercial purposes. Of these three or four parties who are injured by the erratic type of transmitter, the Government and commercial users have become tolerably free because they have developed means of taking care of themselves, and, moreover, they can place good apparatus in the hands of skilled operators. The broadcast listener is the next in order of martyrdom, but his interests are being ably protected by the British Broadcasting Company, which, in this aspect, is a solid single-minded organization for looking after the broadcast listener. The real martyr is, I think, the true amateur of the kind that forms the bulk of our Society. This man, when broadcasting began, bound himself of his own initiative by a self-denying ordinance to refrain from transmitting during broadcasting hours on the wavelengths that would interfere with broadcasting reception anywhere. In addition to this sacrifice of his experimental time, he found also that if he lived near a broadcasting station he could do no experimental reception during the time the broadcast station was running, on account of the width of band natural to a telephonic station. His work, therefore, became postponed until after 11 o'clock at night. This left the British Broadcasting Company to deal with the inconsiderate or anti-social transmitter who sometimes disturbs the peace. But once these people were scared, they transferred their energies to the post-broadcasting hours, with the dire result that the self-disciplined amateur finds himself at 11 o'clock at night in the midst of a perfect thicket of noise, in many cities, at any rate.

THE EVIL RADIATING RECEIVER

DURING the past year the British Broadcasting Company has kept in close touch with our late Honorary Secretary, Mr. McMichael, and have sent him copies of many of the complaints which they have received from disturbed broadcast listeners. Mr. McMichael started last March a scheme for mobilizing local wireless societies in the work of tracking and, if possible, eliminating the disturbers; but he found, I think, that it would require much labor and much money to carry out thoroughly any scheme of this kind, and I think that in the end his efforts gradually tapered off on account of the sheer impossibility of the task. Even in districts where it has been possible to trace and stop one howler, two or three new ones have started up for each one stopped. The reason is that the rapid expansion of broadcast listening brings in some new beginner with a valve set every day or every week, according to the district, and the beginner requires time to learn the set. Some of them learn to adjust it silently and to leave it alone within a month; but the weaker vessels take six months, and have then not yet concluded.

Lately I looked through a batch of recent letters of complaint of programs spoiled and I tried to diagnose in each case the probable source of the trouble. About three quarters of the disturbers seemed to be valve learners, but they, as a source of irritation, disappear in a few weeks or months. A small fraction were chronic crystal ticklers who, if very near to sensitive neighbors, cause great mental distress. I daresay that many of you know that if your next-door neighbor insists on scratching his crystal while his antenna is oscillating strongly under the broadcast waves, he radiates every scratch to you and spoils your music and language. To these people one can only quote Lord Palmerston and say: "Why can't you leave it alone?" But it seems to be too much to ask human nature to leave well enough alone, for even after obtaining an excellent rendition they say to themselves, "I wonder if it would be better if I turned that knob a little farther," and so it goes on.

With these classes of disturbers very little can be done by any society like ours, or by the Government, or by the British Broadcasting Company. We in this Society have seen enough of the complaints and looked at them carefully enough to be sure that the stopping of that trouble is as great a problem as suppressing the piano-playing of a neighbor or

suppressing the nocturnal cat. It is just a nuisance, and it may have to be tackled in due course under the common law as a nuisance. As a rule the common law has succeeded in adapting itself in due time to deal with all newly invented nuisances that civilization brings; but to return to the analysis of complaints of broadcast listeners, I think about ten per cent. of the disturbances are due to amateur transmitters, and under ten per cent. due to wilful interference. You will, I think, agree with my seemingly harsh diagnosis of the latter category, the wilful interferer, when I tell you that in the interferences sometimes recorded, the interpolations consist of remarks, at apparently appropriate points of the sermon, of such words as "rats!" Now, of course, that cannot be accident, it is someone with a transmitting set and a gramophone who is intentionally creating a nuisance. I say that less than ten per cent. of the broadcast complaints seem to come into the category of wilful disturbance.

MEETING THE COMPLAINTS

CASES like this do, in a sense, concern the wireless societies, and they must be grappled with if we can trace them to our membership, but the cases where the genuine amateur transmitter is interfering with the broadcast listener is in a different category and requires special consideration. In the first place, many of the complaints of the broadcast listener arise because his apparatus is so badly designed or constructed that though it is tuned to 365 meters it is easily disturbed by a transmitter at 180 meters, for example. From the scientific point of view, the remedy is simply a filter circuit in the listener's antenna; but from the popular point of view, the amateur is a person who is merely playing with wireless, and when the would-be listener to the broadcast concerts comes near to him and installs poor apparatus, the assumption is that it is the amateur who must shut down. This, of course, is a gratuitous assumption that the broadcast listener has a stronger right to install poor apparatus than the transmitter has to transmit on a reasonably sharp wavelength. But it does not follow that because a man listens in to, is it Uncle Jeff (?), that he is therefore a better citizen than an experimental transmitter. But that kind of thing has always haunted scientific inquirers. Entertainment, for instance, is, to unthinking people, much more important than any possible good, national or social, that may flow from a scientific study or hobby. This has been the attitude of the crowd toward the discoverer and investigator throughout all history. In all such cases those who know better have had to combine and fight those who know nothing. In this particular case we are combining as a society, but we can only meet the unreasonable complaints of the ill-equipped amusement seeker by our being sufficiently strongly organized to demand impartial inquiry and to insure a just decision. On the other hand, we can meet the justifiable complaints of the other users of wireless, and can obtain more time for ourselves and clearer times for ourselves, by getting every well-intentioned amateur to join our Society or an affiliated society, and after that establish a code of honor and a system of self-discipline amongst ourselves.

THE RESULTS OF THE $500 BROADCASTING CONTEST

WILL be announced in a forthcoming number of RADIO BROADCAST. Over eight hundred manuscripts were entered in the contest and the task of selecting the best is proving a difficult one for the judges. The contest judges are Professor J. H. Morecroft, President of the Institute of Radio Engineers, Powel Crosley, Jr., President, the Crosley Manufacturing Company, Frank Reichmann, of the Reichmann Company, Chicago, Senator Royal S. Copeland, New York, and Harry Chadler, Publisher, Los Angeles TIMES.

THE WHB RADIO ORCHESTRA
Whose lilting dance music floats out to receptive radio listeners all over the nation

"Meet" the Radio Voices from Kansas City

A Bit About Some of the Popular Artists Who Broadcast from WDAF and WHB

By ERLE H. SMITH

A BITTER war is on in the ranks of radio listeners of the "Heart of America" city—Kansas City. Unconsciously and yet not unwillingly, whole groups of these radio partisans have fallen into clans. And in many homes, radio dealers say, arguments have grown so heated that it has been necessary to install a receiving set for each radio fan in the household as a final effort to lure the dove of peace back to a permanent roost on the domestic antenna.

For it develops that the listeners-in of Kansas City in common with those of many other cities have their favorite ether performers just as decidedly as theater goers have their stage favorites. And when WHB and WMAJ are on the air at the same time and Sallie craves to listen to the Sweeney orchestra, Bill is out of luck for that lecture on wave traps over WMAJ. So Bill has his receiving set, be it ever so humble, and Sallie has hers and there is peace in the domicile of the listeners and, I think, a smile on the face of the radio dealer.

NELL O'BRIEN
Who gained great popularity at station WHB. She is a soprano

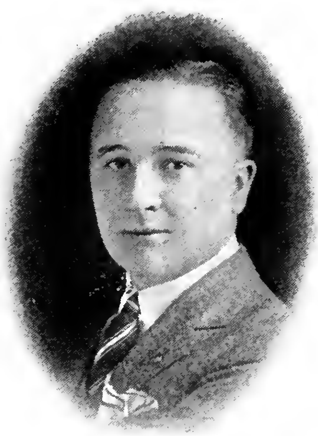
LOCAL RADIO FAVORITES IN KANSAS CITY

OUTSTANDING among the radio favorites of Kansas Cityans are the *Kansas City Star's* "Nighthawks." The regular "Nighthawk" entertainers, known from coast

to coast and Gulf to Lakes, are the Coon-Sanders orchestra and Leo Fitzpatrick, Radio Editor of *The Star* and "Merry Old Chief" in charge of the midnight frolics of the "Nighthawks" in the grill of a downtown hotel. The "Merry Old Chief" also appears before the microphone in *The Star's* studio as "R. A. Dio" in regular weekly minstrel programs.

The "Nighthawk" programs were among the first attempts at midnight broadcasting on a regular schedule six nights a week and have been running full blast every night except Sunday for nearly two years. Listeners-in, picking up the "Nighthawk Frolic" and writing or otherwise communicating with the WDAF station are enrolled on the membership roster of the "Nighthawk" organization and awarded membership cards. The roster includes thousands of names.

THE RADIO TRIO
Often heard from WDAF, at Kansas City. Carson Robinson (left), Steven Cady (center), and Harry Kessel



LEO FITZPATRICK
Radio editor of the *Kansas City Star*, WDAF, and "Merry Old Chief" of the *Star* "Nighthawk Frolic" programs

Ranking second in popularity with Kansas City listeners in the ranks of the WDAF entertainers is the Radio Trio, composed of Carson Robinson, Steven Cady, and Harry Kessel. Mr. Robinson is a pianist and whistler, if not of note, at least of great popularity, and has written several "blues" song hits and chimes in with his effective baritone when the trio is singing ensemble. Mr. Cady has an excellent tenor voice, and Mr. Kessel is the trio's "lead" and usual soloist.

Assisted by "R. A. Dio," the trio gives a popular program weekly over WDAF, which, judging from the hundreds of letters pouring into the office of *The Star's* radio editors, indicate nation-wide approval.

The station of the Sweeney Automotive and Electrical School, WHB, claims to be the first broadcaster west of the Mississippi River to employ a regular orchestra. George C. Parrish, known among music critics of the Southwest as one of the most able and versatile pianists in Kansas City, is director of the orchestra. The popularity of Mr. Parrish's orchestra is

ELIZABETH R. HINTON
A popular soprano at station WHB

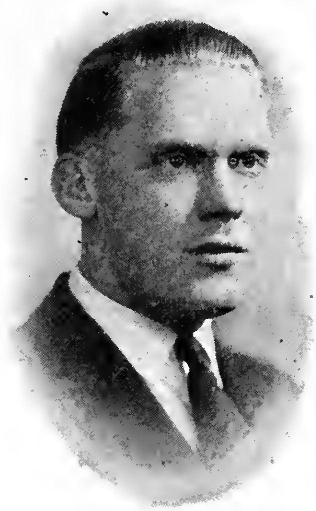
JOE SANDERS (left) AND CARLETON COON
Leading lights of the Coon-Sanders "Nighthawk" orchestra who regularly play at station WDAF. Mr. Sanders is a pianist and composer. Mr. Coon is the trap drummer. Both have excellent voices

proved by the great quantity of enthusiastic letters that are received by the Sweeney station weekly from all sections of the western hemisphere.

The Sweeney orchestra is probably one of the most popular dance combinations with Kansas City listeners-in. Far-away owners of neutrodyne and super-heterodyne sets nightly notify the Sweeney station that they are concentrating on bringing in WHB "strong" to provide music for dancing. And then, Mr. Parrish and John T. Schilling, the WHB announcers, get their heads together and release some of the "steppin'est" music that travels through the ether from what the local boosters call the "Heart of America" city.

Miss Nell O'Brien and Mrs. Elizabeth Ranson Hinton, sopranos, are popular radio stars appearing exclusively before the microphone of WHB. Both have exceptional voices, and nights when they are on the programs are certain to be busy ones for the telephone operators at the Sweeney switchboard, for its "Please have Miss O'Brien sing" this and "Please have Mrs. Hinton sing" that.

And so it goes with the radio listeners of Kansas City and the surrounding territory.



JOHN T. SCHILLING
Announcer at WHB, at Kansas City, the Sweeney Automotive School

They have their radio favorites and they keep the telephone wires warm telling the two large broadcasting station operators just what they desire to hear.

A REPORT FROM THE RADIO PILGRIMS

ABOARD the RADIO BROADCAST COVERED WAGON, in charge of Captain Jack Irwin, will be a feature of this magazine for December. Captain Irwin relates his impressions of radio life in the Great Lakes district. His "Log of a Radio Hobo" is worth reading.

Modern Receiving Circuits

The Function of the Crystal Circuit—The Types of Regenerative Circuits—Receivers Using Untuned Radio-Frequency Amplification—The Super-Regenerative Circuit and Its Value—The Inverse Duplex

WHAT MAKES THE WHEELS GO 'ROUND: VIII

BY WALTER VAN B. ROBERTS

AS AN excellent conclusion to Mr. Roberts's discussion of the workings of the various elements of receiving circuits, the present article, the eighth in his series: "What Makes the Wheels Go 'Round," discusses in very clear fashion some of the most generally used receiving circuits. This series of informative and exceptionally lucid explanatory articles can be read with profit by every broadcast listener, even he who feels his technical knowledge is perhaps a little better than the rest.—THE EDITOR.

FIGURE 44 shows the simplest possible receiving set. Tuning is sufficiently well accomplished by a switch connecting to different taps on an inductance coil of any type. A cylindrical coil with a sliding contact is often used. This type of receiver is very good for reception of stations up to about 25 miles distant provided there is no interference. It is about the least selective of any radio circuit and cannot tune out interfering signals

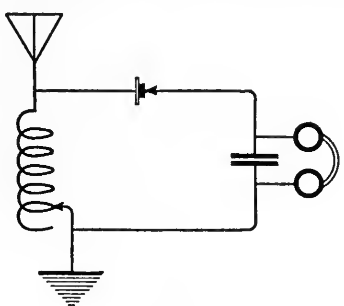


FIG. 44
A simple crystal receiver. Probably the least selective of any circuit in use

even if on a different wavelength. Fig. 45 shows a two-circuit or loosely coupled type. The sensitivity is about the same as that of the single circuit but there is considerably better selectivity. Any circuit using a crystal is subject to the nuisance of having to keep the crystal in adjustment. Some crystals jar out of adjustment very easily and a search must then be made for a "sensitive spot."

66. SIMPLE DETECTOR CIRCUITS

A VACUUM tube may be used instead of a crystal in either of the above circuits, thus eliminating the trouble of finding a sensitive spot. Otherwise the results will be about the same, except for a gain in selectivity. See Figs. 46 and 47.

67. REGENERATIVE CIRCUITS

THE chief advantage in replacing the crystal by a tube is the possibility of using regeneration. Figs. 48 and 49 show regeneration accomplished by inserting inductance in the plate circuit of the tube. If this is a

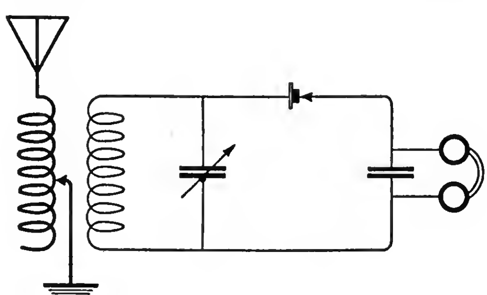


FIG. 45
An inductively coupled crystal circuit. Both antenna and detector circuits are tuned and hence the circuit is more selective. Receivers based on this circuit were standard for many years until the vacuum tube came into general use about 1915

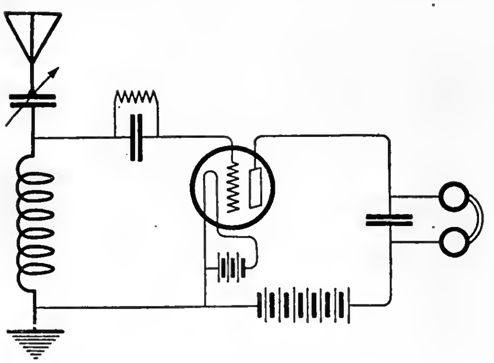


FIG. 46

A simple vacuum tube circuit, in which the tube does not oscillate, but is used as a rectifier, serving the same purpose as the crystal detector in Figs. 44 and 45. Note that the antenna and detector (or secondary) circuits are conductively coupled

small fixed coil it is coupled to the grid coil and acts as a tickler. If it is not brought up near the fixed coil it must be a variable inductance, i. e., a variometer. The two circuits shown are called the single-circuit and the three-circuit method of using regeneration. This nomenclature is obviously inconsistent but it is customary. The two are equally sensitive and for differentiating between equally faint signals of nearly the same wavelength they are almost equally selective, but with the three-circuit arrangement, it is possible to shut out strong local stations of considerably

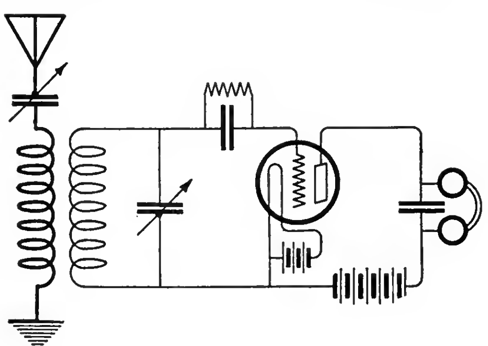


FIG. 47

The same circuit as Fig. 46 except that the antenna-secondary coupling is inductive

different wavelength while the single circuit cannot do this. The single circuit is easier to tune properly, but if allowed to oscillate it is usually radiating more energy from the antenna and hence causes worse interference —that is, the familiar squeals that are often heard while the neighbors are tuning-in. For this last reason there is a growing sentiment against the use of single-circuit regenerative receivers in thickly populated regions or indeed, anywhere else.

There are a great many apparently different regenerative circuits in use, but the above are the standard forms. No one kind is any more sensitive than any other if properly built, as the sensitivity is determined by the tube. Single-circuit receivers are usually built with an eye to the best possible selectivity. They

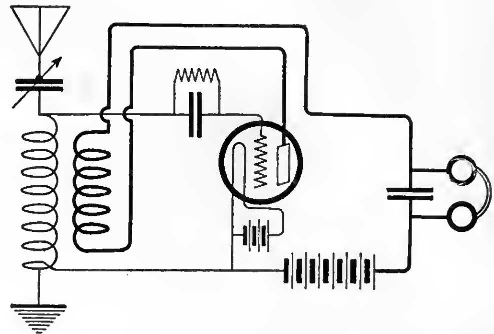


FIG. 48

The circuit of Fig. 46 with the addition of a "tickler" coil, whose purpose is to make the tube detector oscillate, increasing the sensitivity of the circuit. It is a malignant radiator of energy. Sometimes called a "blooper"

are made very "stiff," that is, the antenna is tuned with a large inductance and a small capacity and a comparatively low short antenna (not more than 150 feet over all) is recommended.

68. UNTUNED RADIO FREQUENCY TRANSFORMER SETS

WHERE greater sensitivity is required some form of radio frequency amplification is necessary. Fig. 50 shows a typical three-stage transformer-coupled R. F. amplifier with potentiometer stabilization. Receiving sets of this type are not very selective

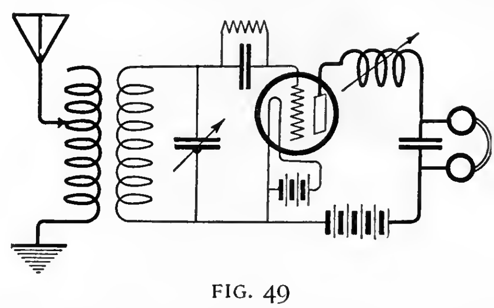


FIG. 49

Regeneration is secured by the use of the variometer in series with the plate of the tube. Simply Fig. 47 with the variometer added

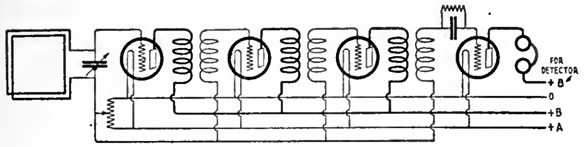


FIG. 50
A radio-frequency circuit with air-core transformer coupling between the amplifier tubes. Note the stabilizing potentiometer

as there is only one tuned circuit to do the selecting. They are easy to operate as the tuning condenser and the potentiometer are the only controls. They are subject to the limitations imposed by the transformers in the matter of range of wavelengths that can be received. Unless an arrangement for plugging in different transformers is provided, the range is usually only about two hundred meters. (From 300 meters to 500 meters for example.)

69. THE NEUTRODYNE

FIG. 51 shows a typical neutrodyne arrangement. Only two stages of amplification are used because three condensers are enough to tune. As each of the three transformers is fairly selective, the result of using all three at once is very good selectivity. An open type antenna is used (this, however, need not be large. Thirty feet or so strung around a picture moulding gives good results except for very weak signals) because a loop is likely to have energy fed back to it from the trans-

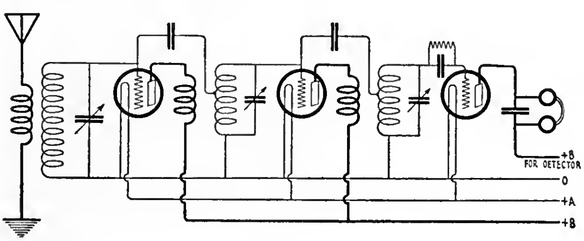


FIG. 51
A neutrodyne arrangement

formers, which are not usually shielded. They could be shielded, but they are usually cylindrical and set at such angles with each other that they do not feed back to each other.

70. ABOUT SUPER-REGENERATION

WHERE loud signals are required from a loop and the number of tubes is limited to one or two, super-regeneration rules the field. Super-regenerative circuits are not very selective and hence not very good for working through interference, but where the desired signal is the strongest incoming ether disturbance in its region of wavelengths, a loop and a single tube can be made to work a loud speaker as well as about three tubes used any other way. The principle of super-regeneration is explicable qualitatively by a mechanical analogy. A clock was used in a previous article as an analogy to give an idea of the mechanism of an oscillator circuit. We shall use the clock again. Suppose it to

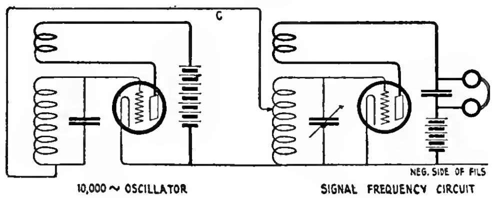


FIG. 52
The super-regenerator. When the low-frequency oscillator grid is negative, the connection "c" between the two oscillators has no effect, and oscillations build up at signal frequency. During the half cycle when the grid of the low-frequency oscillator is positive, oscillations are damped out of the signal-frequency circuit just as if its own grid were positive. The signal is picked up by a loop connected across the tuning condenser

be wound up but the pendulum is placed carefully in its lowest position and left there. The clock will *not* start itself. But now suppose puffs of air come along at the proper interval to start the pendulum swinging slightly. Once it starts ever so slightly, the ideal spring and escapement mechanism we have assumed cause its swinging to increase even if the puffs of air stop coming in. The oscillations of the pendulum "build up" and in due time the amplitude of swing reaches a limit determined by friction, air resistance, etc. But if we confine our attention to a sufficiently short period of time after the swing starts to build up we will find that the amplitude attained during this time is proportional to the strength of the incoming puffs of air. At the end of this period let the pendulum be stopped and set again at its lowest point so that the whole thing can take place again. By this arrangement, a great deal more swinging is done by the pendulum, on the whole, than if the clock were not wound

up, in which case the pendulum would only swing the very small amount caused by the air puffs alone.

In the electrical case we have a circuit all set to oscillate, but "balanced" so to speak so that some incoming ether wave is required to start oscillations building up. The amplitude to which oscillations build up during, say, one twenty thousandth of a second, is proportional to the strength of the incoming signal. The circuit automatically extinguishes the high-frequency oscillations in itself every ten thousandth of a second and "rebalances" itself for another start. Thus, on the average, there is a good deal of high-frequency current in the circuit, and as the amount is proportional to the incoming signal strength at any time, its rectification by the curvature of the tube's grid potential-plate current characteristic yields the signal ready for the loud speaker (unless it is desired to filter out the 10,000 cycle note that is due to the periodic interruption of the oscillator circuit).

Another way of looking at the action of super-regeneration which may seem simpler to some, is to consider the action as mere multi-stage radio-frequency amplification performed by a single tube by the simple process of connecting the secondary of the transformer back to the input of the same tube

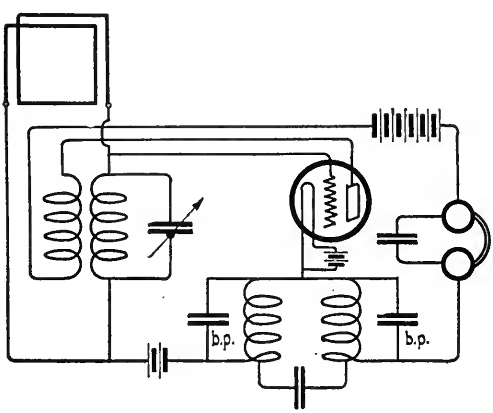


FIG. 53

The super-regenerator. Both low-frequency and signal-frequency oscillator circuits are attached to the same tube. The signal-frequency circuit is at the top of the diagram. High-frequency oscillations pass readily through the bypass condensers B-P. The low-frequency circuit (here a Hartley, with or without mutual inductance between coils) is supposed to be oscillating all the time. During part of each cycle the grid and plate potentials favor the building up of high-frequency oscillations in the upper circuit, but during the other part, conditions are unfavorable and cause oscillations, if any have built up, and die out again

instead of the input of another tube. A small impulse comes into the grid of the tube and is amplified and fed to the primary of a transformer, the secondary of which feeds it back to the grid. It then makes another round trip, and another, and another, and sooner or later would grow so great that the tube could no longer amplify it any more. But before that happens, the interrupting mechanism comes into play and wipes it out entirely. The interrupting mechanism then stands aside, figuratively speaking, and lets the tube amplify whatever is supplied to its grid for another twenty thousandth of a second or so, then steps in and quiets everything down again. Thus on the average there is much more radio-frequency current than the incoming radio waves alone could produce without help.

The reason that super-regeneration works best at short wavelengths is that the time between interruptions is then enough for a large number of round trips and the current can build up to large values before being interrupted. The interruption frequency cannot be lowered to less than about ten thousand per second or it becomes annoyingly audible.

Three systems for doing the interrupting are—

(1) making the grid so positive, once every ten thousandth of a second, that the oscillations are killed as explained under stabilization by potentiometer in radio-frequency amplification,

(2) by periodically cutting off or reducing the amount of plate potential and allowing the oscillations to die out, and

(3) by combining these two methods.

The first and the third are recommended, the third having the advantage of using only one tube. The second is difficult as the oscillations do not always die out rapidly enough by themselves even when the plate potential is reduced far below the value necessary to make oscillations build up. It is important not to have any tuned circuits around in which oscillations can persist, as they will re-excite the oscillator even if no signals are coming in. For this reason the selectivity can not be improved by the ordinary loose coupling of tuned circuits, although advantage may be had by operating the set in the same room with the lead-in of a tuned antenna. Fig. 52 shows the first system, 53 the third.

71. PRINCIPLE OF REFLEXING

WHEN a tube capable of amplifying a strong signal is used merely to amplify a weak one, its power-amplifying capability

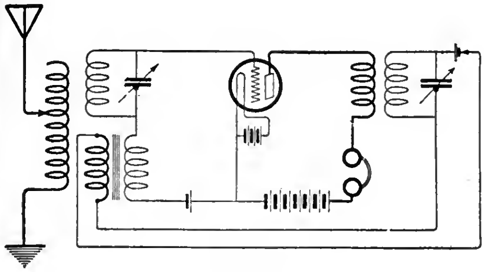


FIG. 54
A simple reflex circuit, using a crystal detector. The one tube in the circuit acts both as a radio- and audio-frequency amplifier

is not being made efficient use of. "Reflexing" is a system for getting more out of a tube by making it amplify two things, the incoming signal at radio frequency, and the detected, or audio frequency current. So long as the variations of grid potential due to both frequencies are each of small amount, neither interferes with the other. Fig. 54 shows a very simple reflex circuit using a crystal detector. The radio-frequency current after being amplified is fed by means of a tuned transformer to the crystal. The audio-frequency current is then fed to the grid and amplified, the phones being in the plate circuit of the tube. The frequency of the radio current is so much greater than that of the audio that the two kinds of current are easily separated whenever necessary. Fig. 55 shows the flow of energy in diagrammatic form. Fig. 56 shows the energy flow in a two-stage amplifier.

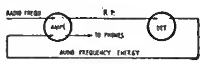


FIG. 55
Diagram of the current flow in a reflex circuit

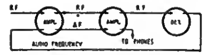


FIG. 56
Diagram of the energy flow in a reflex circuit where the energy is amplified through two audio stages

FIG. 57
The inverse duplex arrangement, which is an elaboration of the reflex idea

72. THE INVERSE DUPLEX SYSTEM

A REFINEMENT of reflexing as shown above is the arrangement called the inverse duplex, shown in Fig. 57. It is obvious that the tube carrying the least radio frequency energy is the one that handles the greatest audio-frequency energy, and vice versa. Thus the point of overloading is not reached so soon. Also, as the audio energy is not fed directly back to the first tube, any accidental radio-frequency feed back that might occur along with the audio feed back will not be so likely to cause oscillations.

T. M. STEVENS
Assistant Traffic Manager of the Radio Corporation of America. Mr. Stevens has charge of the radio message traffic operation of the many passenger and cargo ships controlled by this company

Final Plans for the International Broadcasting Tests

News of Importance for Every Radio Listener in the Outline of RADIO BROADCAST'S Tests for 1924

By ARTHUR H. LYNCH

THERE is little time left for you to get ready for the international broadcasting tests which are to take place between November 24th and 30th, inclusive. For the first time you will have an opportunity to test the possibilities of your receiver for picking up long distance broadcasting, under the best conditions obtainable.

RADIO BROADCAST carried on a similar series of tests last year and hundreds of listeners in the United States and Canada were able to pick up parts of the programs from England, while our English friends were even more successful in picking up our programs. If you remember, there were many prominent speakers in this country who said a few words for our English friends and prominent Englishmen spoke to us. The reception of the English stations in this country could hardly be called a complete success, even though we have had verified reports from American listeners who were located as far west as Washington State. We have every reason to believe that the tests this year will be even more successful and, having this in mind, we have set out on a rather enlarged program.

The principal difficulty in connection with the tests last year was the very limited time we had to get them under way and the failure on our part to recognize until it was too late, the terrific amount of detail work the tests would involve. Most of communications were with Hugh S. Pocock, Editor of *The Wireless World and Radio Review* (London), whose hearty coöperation made it possible for us to work so closely with the British Broadcasting Company.

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HUGH S. POCOCK

Editor of the London *Wireless World and Radio Review*, who is working in close coöperation with RADIO BROADCAST in directing the second international broadcasting test. Mr. Pocock has charge of arrangements for England and the Continent and is working with Captain A. G. D. West, assistant chief engineer of the British Broadcasting Company

The time for preparation was so short that most of our communication with the American broadcasting stations had to be done by telegraph, and if you remember, even that method of communication proved futile in several instances because the managers of stations had important events scheduled for the hours of the test periods. Other broadcasters were not convinced that the listeners in their audience were as much interested in attempting to pick up London as they were in hearing some really good music from the home station. For the first few nights of the tests, many of the broadcasting stations in this country and Canada did not shut down and it was only by telegraphing them individually that we were able to secure a comparatively quiet ether for the last night.

Then, too, in the larger cities and other comparatively thickly populated areas there was a terrific amount of interference caused by radiating receivers. Interference of this nature was so great in the vicinity of New

York, Boston, Chicago, and several other cities, that even those in the suburbs found it difficult to hear anything but the squeals. Many newspapers published editorials criticizing the "bloopers" unmercifully.

There were many other reasons for our not having scored a complete success, but they are of little interest now, other than object lessons, and we are making every effort to surmount the difficulties and there is every reason to believe that we will do it.

WHY WE LOOK FOR SUCCESS THIS YEAR

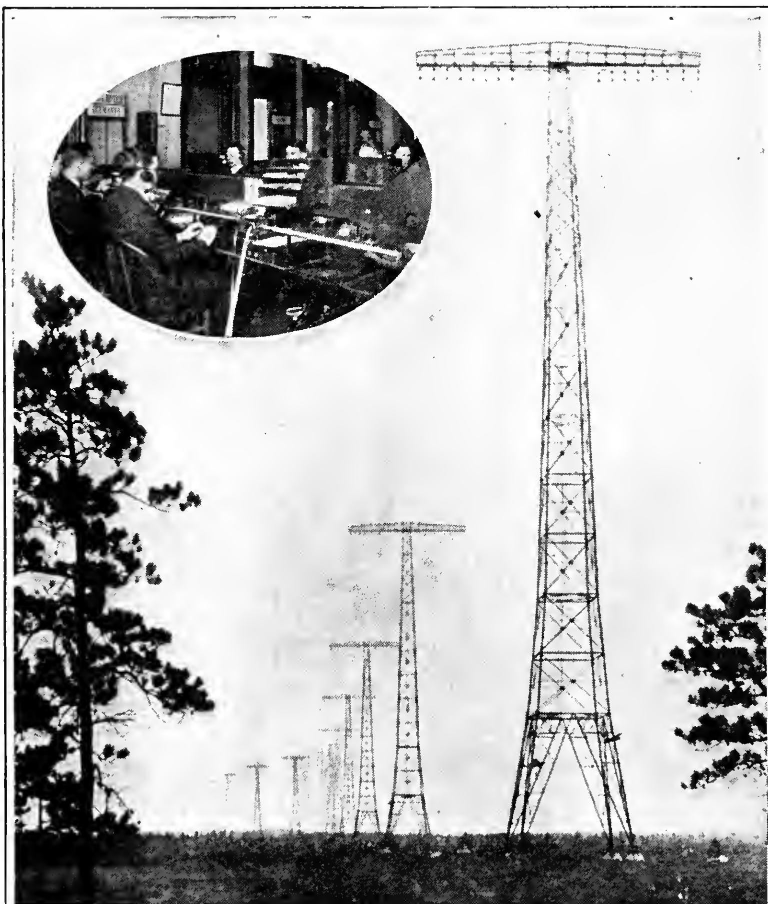
IN ENGLAND, we still have the active co-operation of Mr. Pocock and Captain Eckersley of the British Broadcasting Company as well as the additional effort of the Radio Retailers' Association, of which Clifford and Clifford are the Honorable secretaries, and the Radio Trade Association of New York. L. A. Nixon is Secretary. All are working together, to make every possible wheel move in the correct direction and without either lost motion or friction.

In Canada, Jacques Cartier, Manager of the *La Presse* Broadcasting station, at Montreal is doing his best to coordinate the efforts of the Canadian stations.

In Cuba and Porto Rico we have been able to enlist the services of PWX, 2MN, 2BY, Havana, 6KW, Tuinucu, Cuba and WKAQ.

In this country no effort is being spared. A circular letter, addressed to every broadcasting station in the United States has resulted in replies having been received from most of the important broadcasting stations in the country. The larger stations have signified their intention to take part in the transmission tests and even the smaller stations, which do not feel that there is a possibility of being heard by European listeners, have very generously volunteered to keep off the air during the periods during which we will attempt to hear from Europe.

Captain Jack Irwin, who is piloting RADIO BROADCAST'S COVERED WAGON across the country in an effort to reduce the amount of



HOW THE NEWS WILL REACH ENGLAND

The masts of Radio Central of the Radio Corporation of America at Riverhead, Long Island. Direct radio telegraph communication will be maintained through the Broad Street control office (in the insert) direct from the RADIO BROADCAST Laboratory at Garden City to the office of the British Broadcasting Company in London. When the English programs are heard, the flash will go from a telegraph key at the magazine's laboratory which will signal the English company a fraction of a second later in their London offices

interference from power lines, etc., has visited a number of broadcasting stations and told the story of these tests to thousands of listeners, to say nothing of the manufacturers and dealers with whom he has discussed our plans.

Other members of RADIO BROADCAST'S editorial staff have visited broadcasting stations in the Eastern, Middle Western parts of this country and a portion of Canada. In almost every instance these talks have been brought to a close by an exortation to the listeners to prevent their receivers from squealing during the tests and it is hoped that these requests will be complied with.

Since last year the British and other European stations have been improved greatly, and there is little doubt but that many of them will be heard throughout North and South America this year.

VAST IMPROVEMENT IN RECEIVERS

DURING the past year there has been a marked improvement in the design of receiving apparatus used in this country. For instance, there were but few neutrodyne receivers in operation during the tests last year and many of them were home-made and not very well adjusted. We have learned a lot about the neutrodyne since that time and there is no reason why hundreds of them will not pick up the other side this year. This is particularly true, if the detector is made regenerative, which may be done without a lot of trouble.

Then, it will be remembered that but little was known of the super-heterodyne, except by the old-timers, and it is expected that there will be many "supers" focussed on Europe during the coming tests. Many of them will be successful. And right here it may be well to say a word about the operation of "supers."

JACQUES N. CARTIER
Manager of station CKAC, *La Presse*, Montreal, who will work with RADIO BROADCAST in arranging the international broadcasting tests as director of Canadian broadcasters during the tests

Where it is necessary to use an outside antenna with a super-heterodyne in order to insure proper signal strength, there is something the matter with it. Where an outside antenna is used, it is folly to waste tubes and batteries with a "super," there are other receivers capable of similar results, with a great saving. There is every reason to believe, from the tenor of the reports we receive from our readers, as well as from our own observation, that many of the English stations will be picked up this year on our own Two-Tube Knock-Out Receiver. It is gaining in popularity because it performs extremely well, is easy to build and is very, very economical. Where an antenna is used, it is doubtful that many home-built super-heterodynes will be able to boast a better performance record.

Nearly every newspaper in the country has printed something about these tests, and we wish to express our appreciation for this coöperation. It is also gratifying to be able to tell you that the General Electric Company, which coöperated so thoroughly with us last year is doing the same thing this year. Then, too, it would be almost impossible for us to keep in close touch with the other side, during the tests, without seriously interfering with the program, if it were not for the assistance given us by the Radio Corporation of America. This corporation has arranged to have a direct wire connecting our receiving station at Garden City and its New York office, and thus connected with Europe via its high power radio telegraph circuit.

The Westinghouse Electric and Manufacturing Company has also agreed to take an active part in our tests and has promised that all of its stations will conform to our schedules

as well as arrange special programs for our foreign friends.

To outline the plans of the various companies which are coöperating with us would be a tremendous task and space does not permit, so it may be well to confine our description to a few of the preparations we are making ourselves.

PREPARATIONS AT GARDEN CITY

RADIO BROADCAST'S Laboratory is situated about three hundred feet from our main building and was erected principally to house the elaborate receiving equipment used by those engineers who came out last year and set up their outfits beside our own. Here there will be a direction finding loop antenna, of the Bellini-Tosi type about eighty-five feet high. There will also be a number of smaller loops, for use with various receivers. The Lab. will, as we have stated, be in direct wire connection with the Broad Street office of the Radio Corporation of America, as well as in telephone connection with our main building, and radio telephone communication with the two or more field stations we are placing on the seashore about ten miles from our main building.

At the field stations there will be as complete equipment as is necessary, and we expect to use several of the Knock-Out Receivers as well as a series of super-heterodynes. At these field stations there will be radio telephone transmitters, operated on short waves to communicate with the Lab. The reason for using radio telephone is to permit us to use a shack right on the shore and as far from telephone, telegraph, trolley wires, and whistling receivers as it is possible to get. The location of our field stations has not yet been decided, because their choice must be made after covering the ground with a portable super-heterodyne receiver in an automobile. This work is under way and all the preliminary work will be done before this magazine gets in circulation.

Licensed operators of RADIO BROADCAST'S staff will be in charge of the field and Lab stations and will keep the wheels moving properly. A number of receiving sets are to be installed in the field stations by independent engineers, in the same fashion as last year, and a number of receiving sets of various kinds will be located in various sections of the country with direct wire connections, so that immediate reports may be made to our lab station, which will be the center of activity, just as it was last year.

It is impossible for us to keep you properly informed of the developments, as they occur through our own pages, so we have arranged a weekly press release service, which goes to all the broadcasting stations and the newspapers. From these bulletins you may secure all the necessary information concerning wavelength, power, and so forth of the foreign and American stations taking part in the tests. If you are successful in hearing the foreign stations, write, or wire Test Editor, RADIO BROADCAST, Garden City, New York, giving us as much definite information as possible to aid us in preparing the official report of the tests. We cannot undertake to verify all of the foreign programs.

A SHORT ANTENNA RECEIVER

FOR some little while we have been watching for a receiver which would perform in good style with a short piece of wire for an antenna and employed standard coils and parts. Such a receiver would, we felt sure, make a very good portable. We have it and it is an extremely good one. It is a 4-tube set and will be described in RADIO BROADCAST for December, by G. H. Browning of Harvard University. A how-to-make-it article of great interest and value.

The Facts About Resistance

Answering Your Unasked Questions about Potentiometers, Grid Leaks, and Rheostats in Receiving Sets. A Where, When, Why, and How Article

By THOMAS O. SHEARMAN

THERE are three fundamental units in radio, upon which are based all the various types of receiving circuits. They are inductance, capacity, and resistance. While inductances and condensers have been perfected to a high degree, and are used as the important factors in most radio circuits, very little has been said about the variable resistance, yet if properly utilized, it plays a very important part in obtaining better results from present-type equipment. Resistances are used in receiving circuits as

Variable Grid Leak B-Battery Control
Rheostat Radio-Frequency Amplifier
Potentiometer Audio-Frequency Amplifier
Audio-Frequency Filter and Tone Modifier

THE VARIABLE GRID LEAK

TO UNDERSTAND properly the variable grid leak, it is necessary to know just what happens when it is placed in the grid circuit of the detector tube. This action is as follows: When the filament of a vacuum tube is brought to incandesence by the A battery, a large quantity of negative particles (electrons) are liberated from the filament, and if the grid and plate connections are left open, the electrons will fall back on the filament so that a state of equilibrium will exist. If, however, the positive terminal of a B battery is connected to the plate, the negative charges instead of returning to the filament will be attracted to the positively charged plate in accordance with a fundamental law of electricity, which states that, "like charges repel each other while unlike charges attract." This invisible stream of electrical energy acts as a conducting path for the B-battery current which flows steadily and uniformly.

Situated between the filament and the plate is the grid element, and it is the action of this member which causes fluctuations in the plate current by controlling the action of the electronic stream. When the grid is connected to the antenna circuit in the usual manner through the grid condenser and the circuit tuned to resonance with the incoming radio-frequency currents, it will acquire a positive and negative charge according to the positive and negative cycle of the incoming radio-frequency wave.

Assuming the first part of the cycle impressed upon it to be positive, a small amount of the electrons given off by the incandescent filament will be attracted to it, and the plate current will be unaffected, but on the negative part of the cycle when the grid acquires a negative charge, the electronic stream will be practically blocked.

This action can be more clearly understood by Fig. 1, where A represents a radio-frequency impulse caused by the closing of a key in a spark transmitter, thus at O the condenser begins to charge and reaches its maximum at point 1 whence it again decreases to zero at point 2, the same action takes place at 3 and 4 but is of opposite polarity.

The positive charge impressed upon the grid causes a small amount of the electrons to be attracted to it at each positive charge which will also cause a negative voltage to accumulate upon it. If the tube is of the high-vacuum type and the socket constructed of perfect insulating material, there will be no possible way for this negative charge to leak off of the grid and will completely repel the flow of

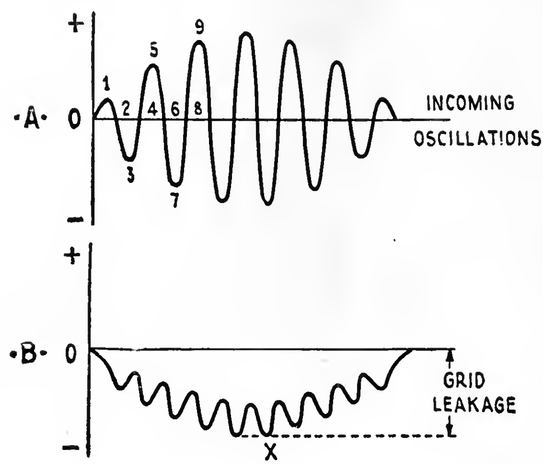


FIG. 1

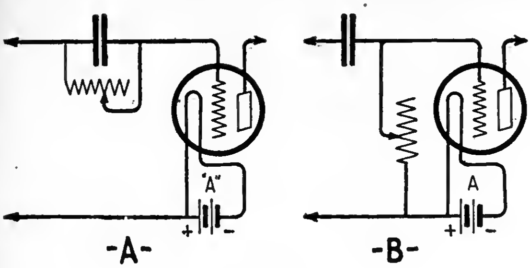


FIG. 2

Quite a few variable grid leaks have been placed on the market which are mechanically imperfect. In some, after a few turns on the handle, the resistance range was changed entirely since the lever rubbed off the resistance material. The grid leak soon became inoperative. Others composed of a semi-fluid material soon dried out and became useless. Faults such as these in the variable grid leak are so hard to find that it is advisable to purchase the best possible.

electrons from the filament, thereby causing the tube to "block." This action is shown as a dotted line X in Fig. 1B. To prevent this accumulation of negative voltage upon the grid, a high resistance is placed either across the grid condenser or from the grid to one terminal of the filament as shown in Fig. 2 A and B, this resistance should be of such a value that it will prevent the radio-frequency carrier wave from leaking off. It would allow only the modulated audio-frequency wave to leak off at the proper moment; when this occurs the grid potentional curve will follow the modulations of the incoming oscillations as shown in Fig. 1B.

Because of its high resistance the grid leak is measured in megohms, (Meg is the Greek prefix for one million,) so when a grid leak is said to be of five megohms value it means five million ohms. Various types of tubes when operated as detectors require different values of grid leakage; this range usually is between one half to five megohms and for this reason it is advisable to equip the receiving set with a variable grid leak, but in purchasing this kind there are four important points to be considered if good results are to be expected, they are as follows:—

Mechanically Correct
Non-Microphonic
Non-Hygroscopic
Uniform Vernier Action

If the variable grid leak becomes microphonic, a rasping sound will be heard when it is adjusted and may continue as long as the set is in operation. When the leak is composed of an india-ink line or some other hygroscopic material and left exposed to the surrounding atmosphere a certain amount of moisture will be absorbed, decreasing its resistance.

This effect will be quite noticeable on a damp day and will cause the grid leak to become quite unstable in operation.

PROPER METHOD OF CONNECTING THE VARIABLE GRID LEAK

THE most satisfactory type of grid leak is one which is conveniently mounted on the panel with the rest of the controls. The connection should be as shown in Fig. 2 B where the terminal farthest away from the panel is connected to the grid and the terminal nearest the knob is connected to one leg of the filament. In this way the hand comes near to the neutral filament side instead of the grid and therefore prevents hand capacity effects.

THE RHEOSTAT

THE most familiar use of resistance in radio-receiving circuits is as the rheostat for controlling the filament intensity. To understand the importance of the rheostat one must have at least an inkling of its technical function; this is briefly as follows. A metal as well as all other substances is composed of a vast number of electrons which are continuously in a state of vibration. When heat is applied to the metal the movement of its electrons is so increased until they break away from the metal and travel away from it at a high velocity, this velocity depending upon the plate voltage. If the amount of energy which heats the metal (which in the case of the vacuum tube is the A battery) is increased, the number of electrons emitted is also increased, until we

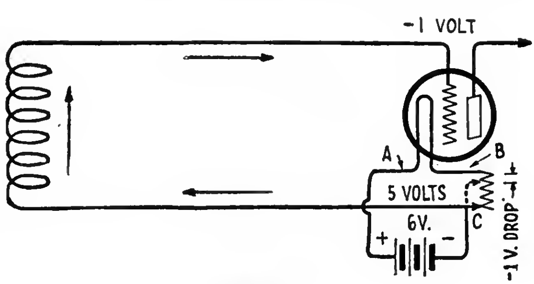


FIG. 3

reach the point of incandescence where a further increase in temperature will cause the metal filament of the tube to vaporize. When this happens the tube "burns out" and is useless.

The function of the rheostat is to give accurate control over the voltage and current passing through the filament. The temperature of the filament governs the flow of electrons from it. Thus the rheostat serves two purposes. First it protects the vacuum tube, when properly adjusted, and prevents an excessive amount of current from flowing through the filament. For example, the storage battery type of vacuum tube operates at five volts while the storage battery delivers six volts (in practice this will be found to be a little less due to the discharge and load applied to the battery), therefore the resistance in the rheostat must absorb the remaining volt. This is shown in Fig. 3 where the rheostat is placed on the negative terminal of the storage battery lead, and is so adjusted that only five volts are applied to the filament terminals A and B, while the other volt is dropped across the rheostat resistance B and C. The second action of the rheostat is that this one-volt drop across the rheostat resistance is applied to the grid of the tube through the filament return lead, and causes the tube to operate at its proper point on its characteristic curve, provided that the plate voltage is about 45 volts. When it is more than this it is usually necessary to use a greater voltage upon the grid, and this is had in the form of a C battery of three or four volts.

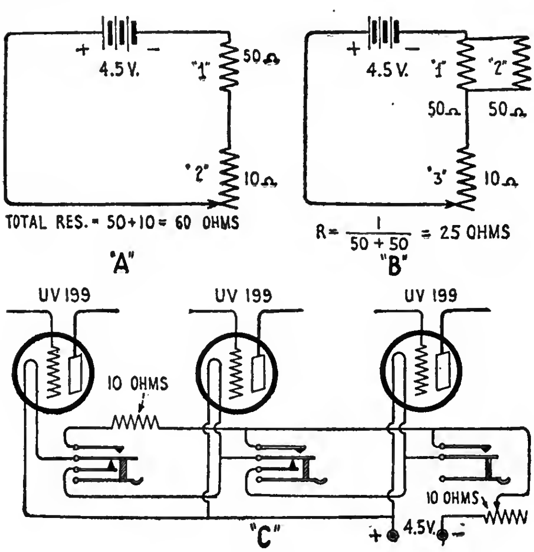


FIG. 4

The three important factors to be considered in purchasing a rheostat are:

Mechanical Construction
Current-Carrying Capacity
Resistance Range

In the wire-wound type of rheostat, the mechanical construction is quite important, and the trouble most often encountered with some now on the market is in the action of the lever when it passes over the resistance wire.

If this lever action is not perfectly smooth, a clicking sound will be heard, especially when controlling the detector tube. And if the contact of the lever is too light, the surface of both the resistance wire and lever will oxidize and collect dust which will offer a high-resistance contact and cause the tube filament to flicker. In the compression type of rheostats there should be no side play. The action of the thread should be perfectly smooth.

The current-carrying capacity of the 30-ohm wire-wound rheostat, due to the smaller-gauge wire used, is not sufficient to carry the filament current of the UV-200 or other high-current consuming tubes. The compression type of rheostat in most cases will handle all of the receiving tubes now on the market.

When the voltage and current at which the tube operates is known the correct-size rheostat can be determined. The normal voltage of the UV-201-A is 5 and current .25. By dividing the voltage by the current we obtain the filament resistance, which is 20 ohms. A rheostat having a maximum resistance of 20 ohms or more will give sufficient working range. If three of these tubes were to be used in parallel and all operated from one rheostat, the resistance required would be about one third or about 7 ohms.

In the article entitled "A Knock-out Three-Tube set" in the February number of Radio Broadcast three UV-199 tubes have their filaments connected in parallel in the circuit shown, as in the usual manner, and have an automatic filament jack for each of the tubes, while a 10-ohm rheostat is connected to the common negative terminal, and the filament voltage indicated is 4.5 volts.

The UV-199 filament voltage is 3 volts and the current is .06 ampere. When one divides the voltage by the current, the filament resistance, 50 ohms, is obtained. When the first jack is closed by plugging in, we have a circuit as shown in Fig. 4A, where 1 is the fila-

ment resistance which is constant and 2 the variable rheostat. When its full 10 ohms resistance is in the circuit, a current of .015 ampere is flowing through it, and .06 ampere is flowing through the filament of the tube.

Thus it is seen that the rheostat resistance of 10 ohms is sufficient to absorb the extra 1.5 volts of the 4.5-volt battery and thus give the filament 3 volts which is its correct amount, but there is absolutely no chance for any filament current variation below this value, for as soon as the rheostat resistance is decreased the filament voltage will be increased beyond its normal rating, therefore a 10-ohm rheostat for controlling one tube is inadequate.

When the second jack is closed, which lights two tubes, we have a circuit as shown in Fig. 4 B where 1 is the first tube filament resistance 2 the second tube resistance in parallel with the first, and 3 the variable 10-ohm rheostat in series with the complete circuit. The total filament resistance of the two tubes is reduced to one half of that of one, or 25 ohms, while the total current consumed by them is doubled, or .12 ampere. About .08+ of an ampere will flow through the two tube filaments and .04+ ampere through the 10-ohm rheostat, thereby leaving .04+ of an ampere for filament variation, which is quite sufficient.

When the last jack is closed the three tubes light. Their total filament resistance is about 17 ohms, and the amount of current consumed .18 ampere, and the 10-ohm rheostat is quite sufficient to give full control over the three tubes.

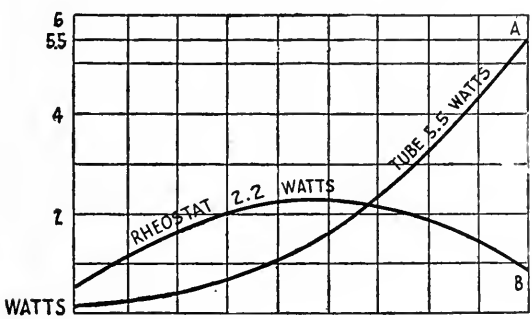


FIG. 5

The only change then necessary for the successful operation of the tube filaments either individually or all together, is that shown in Fig. 4C where a fixed resistance of 10 ohms is inserted in the negative lead of the filament jack of the first tube, this giving 10 ohms possible variation of the filament of this tube.

The layman usually thinks that when the rheostat is turned down and the filament

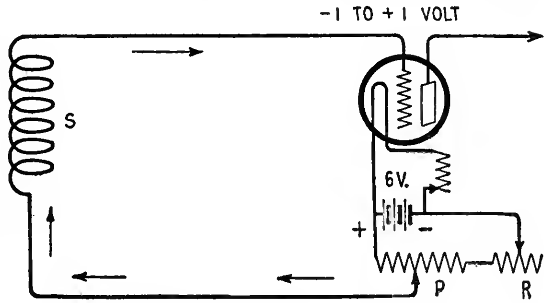


FIG. 6

temperature decreased the current originally used for lighting the filament is then being wholly absorbed by the rheostat. This however is not true as only a small amount of the battery current is being dissipitated in the rheostat. This is shown by the set of curves in Fig. 5 which were taken from an actual test on a UV-200 detector tube and plotted directly in watts, which is the electrical unit for energy. (This is obtained in direct-current circuits by multiplying the current in amperes by the voltage).

Curve B Fig. 5 represents the watts consumed by the rheostat. It reaches its maximum value when half of the applied voltage is dropped across it, its value then being about 2.25 watts, while the maximum wattage consumed by the tube filament (Curve A) is 5.5 watts.

The consumption of electrical energy in the rheostat can never equal that of the vacuum-tube filament.

THE POTENTIOMETER

THE potentiometer in receiving circuits controlls the grid potential and may be used to vary the plate voltage of the detector tube. This second possible use of the potentiometer will be discussed in detail under the heading of *B-Battery control.* For controlling the grid bias in radio-frequency amplifiers the potentiometer has proved most helpful, for in radio-frequency amplifying circuits which are not neutralized there is a feedback action (caused by the transfer of energy from plate to grid—via the tube capacity) which will cause the circuit to oscillate. By varying the grid bias we can control these oscillations and Fig. 6 shows a potentiometer connected

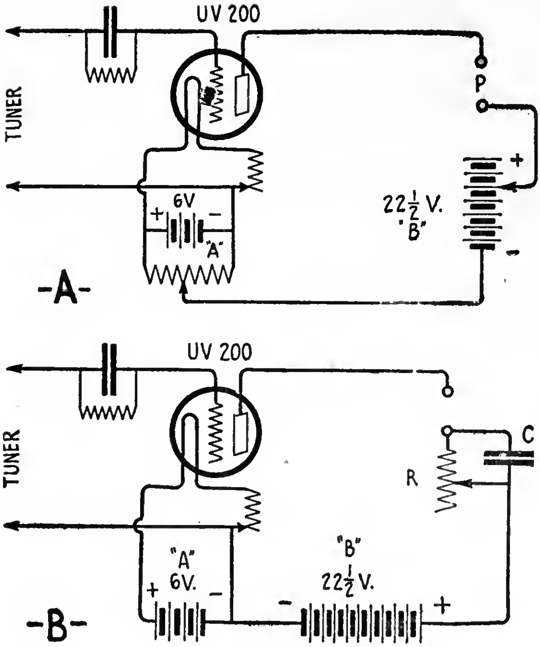


FIG. 7

across the A battery. Its middle movable arm makes connection to the grid through the coil S. In reality it utilizes the voltage drop across the rheostat and applies it to the grid as one volt negative or one volt positive in respect to the filament, or any value between these two.

R is a rheostat of about 6 ohms placed in series with the potentiometer and allows a finer vernier action. When dry cells are used as the A battery, it is advisable to use a potentiometer of from 400 to 600 ohms, as one having less resistance than this will cause the battery to deteriorate in a short time due to the quite considerable current that will flow through a low-resistance potentiometer.

THE B—BATTERY CONTROL

THE most sensitive detector tubes now on the market are the ones containing a small amount of gas, such as the UV–200. When the filament liberates electrons, as described under the heading of Variable Grid Leak, it sends them forth at a certain velocity and unless attracted to the plate by the charge on it maintained by the B battery they will fall back upon the filament. As the plate potential is increased, the electrons are attracted to it at a speed corresponding to the increase in plate voltage, and at a critical point the atoms of gas, which are in the way of the electrons, loose one of the electrons of which they are composed, and then become positive electrical charges and are termed ions. Due to their larger size they offer a much lower resistance path for the B-battery currents, and if too many become ionized the current will become so large that the grid will be unable to control it and the tube will block which can usually be detected by the blue glow around the plate.

It is therefore necessary to accurately control the plate voltage just below the point of excessive ionization, where the signal intensity is high. The two methods for doing this are shown in Fig. 7, where A is the potentiometer across the A battery. The middle movable arm connects with the negative terminal of the B battery. When the arm is moved toward the positive terminal of the A battery (1), the 22½ volts of the B battery are placed in series with the cells of the A battery; if this is of the six-volt storage-battery type, when the lever has reached (1) the total B-battery voltage will be 6 +22½ volts or 28½ volts. For values lower than 22½ volts a tapped B battery must be used, and the plate connected to the lowest tap. Then the range will be from 16½ to 22½ volts.

The second method is to insert a variabe resistance directly in series with the B battery, having a range of from 20 to 15,000 ohms, the voltage can then be varied from about 8 to 28½ volts and a tapped B battery will not be required. This is shown at Fig. 7B with a condenser of .001 mfd. capacity shunted across it for bypassing the radio-frequency currents.

THE RADIO-FREQUENCY AMPLIFIER

THE radio-frequency amplifier may be coupled by high resistances instead of the more usual transformers. Resistances, when used in this manner give very good quiet amplifications on wavelengths above 1,000 meters, but below this wavelength the amplification falls off and at the broadcasting wave frequencies it operates very poorly.

THE AUDIO-FREQUENCY AMPLIFIER

A MORE successful use for the variable high resistance is in the audio-frequency amplifier circuit, where it has the advantage over transformer-coupling because it amplifies all of the audible frequencies with the same degree of amplification, and when the tubes are worked at their proper point on the characteristic curve, the amplification will be free from

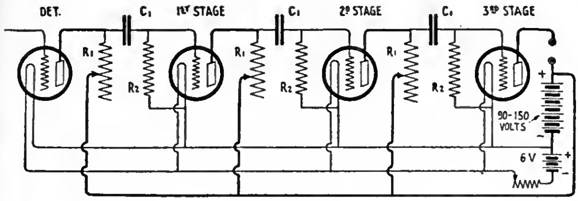


FIG. 8

all distortion. The amplification per stage will not be so great as when transformer coupling is used, but this may be compensated for by the advantage in being able to use three or four stages of amplification without howling.

Fig. 8 shows a three-stage resistance-coupled audio-frequency amplifier. The coupling resistances are variable high resistances having a range of from 10,000 to 100,000 ohms, the fixed grid leaks, R2, about 2 megohms, depending upon the tubes used and the audio-frequency bypass condensers, C, should have a capacity of .01 mfd.

In operation the resistances R1 are adjusted until they match the tube impedance, or when the greatest amount of volume is obtained. The plate voltage should vary from 90 to 150 volts, and it may be necessary to insert a C battery in each stage.

AUDIO-FREQUENCY FILTER AND TONE MODIFIER

THE amplification ratio of the average two-stage audio-frequency amplifier using transformers, is about 1400 to 1. It is therefore to be expected that any local noise, such as that caused by a discharged A or B battery, or mechanical vibration of the receiving set, will be amplified to this high value and is sometimes mistaken for static.

If after disconnecting the antenna and ground the noise continues, one can be certain that the trouble is local. New batteries with the proper protection of the set from mechanical vibration would be the remedy.

Another simple method of reducing unnecessary noise in the audio amplifier is to shunt the last stage of the amplifier input with a variable high resistance having a range from 100,000 ohms to 2 megohms. The proper connection is shown in Fig. 9, and for convenience of adjustment a variable grid leak with such a range is mounted on the panel with the rest of the controls.

Many amplifiers where the transformers are close together and the grid and plate connections parallel, with improper plate voltage or grid bias, will under most conditions emit an audio-frequency whistle which becomes quite annoying. Rather than reconstructing the amplifier which, in most cases is quite impossible, a variable high resistance is used as shown in Fig. 9; if the whistle still con-

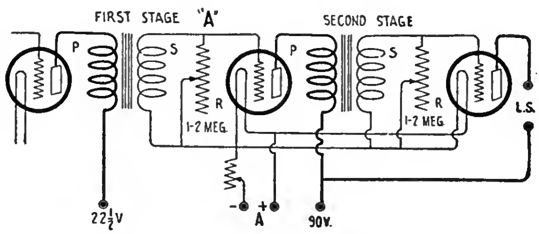


FIG. 9

tinues, another variable high resistance across the first transformer input, as shown at A, Fig. 9, when properly adjusted will in most cases absorb all audio-frequency oscillations.

Another use for the variable high resistance in the amplifier is to prevent distortion. Since many broadcasting stations now are using high power, there is a tendency for amplifiers to become overloaded. A vacuum tube will amplify a certain amount of energy and if this amount is exceeded distortion occurs. This could be prevented by decreasing the plate voltage or filament current, but this would mean retuning the whole circuit. A more practical method is to use a variable high resistance as described above, for by its use the proper amount of energy passing into the tube may be regulated thereby giving clear undistorted amplification.

Avoiding the Squeal in Your Regenerative Set

Simple Instructions on How to Tune Your Receiver so That It Will Not Radiate—Some Golden Rules for the Broadcast Listener

By A. K. PHILLIPI

Westinghouse Electric and Manufacturing Company

THE opportunity afforded the public to-day to listen to good concerts and speeches by men prominent in all branches of science and industry without having to leave their own homes was, a few years ago, unthought of. But how many of you listening-in are sure that your listening-in is not preventing some other person from enjoying some radio program? By this I do not mean that you should lend them your receiving set, but that you, by the improper manipulation of your set, are causing a disturbance in the air that interferes with your neighbors' proper reception of the program.

How many of you, never having driven an automobile, would go to a dealer and buy a car, get in, and drive away, without first being instructed in driving and handling the car? Such a person would be considered a public nuisance and would soon be arrested.

While a person operating a radio set who does not know just what he is doing with it can not endanger the lives or property of others, yet he can cause much annoyance and greatly mar the pleasure of others. The majority of people are good sports and play the game fairly. Those who do cause these radio disturbances are usually those who are unfamiliar with the operation of their receiving units.

When a receiving set of standard make is bought, an instruction book which tells how to operate the unit is generally included with the equipment. A careful study of this book will give the purchaser a fair idea of what to do and how to do it, in order to get the best results as well as to cause the least interference possible while tuning-in the desired station.

It is impossible for all of us to be electrical engineers or radio electricians. Neither can we all be automotive engineers or auto mechanics yet thousands of people drive their own cars in such a way that they bother no one.

Radio listeners are not all good sports, but the majority of them are, and the reason they so often cause disturbances in the air is because they are not generally aware that they do so. It is my purpose to point out some of the things to do and what not to do when tuning-in, so as to prevent disturbances which can be heard by other listeners.

> **The Wail of a Lost Soul**
>
> Need not be heard from hosts of single-circuit regenerative sets if they are intelligently operated. If the user keeps his detector tube adjusted just below the point of oscillation during reception, no wails, squeals, howls, or other sounds not of this earth will be produced such as to drive even the listening minister next door to unbecoming profanity. It is easily possible for the average listener-in, even though he be untutored in the occult ways of radio, to use his single-circuit regenerator in a most harmless and neighborly fashion. The time is not far distant when single-circuit regenerative sets will have disappeared from the radio horizon, but as long as they are in use, their users ought to know how best to operate them so the sets will do as little harm as possible.—The Editor.

HOW TO TUNE-IN—MORALLY

FIRST of all, the radio set should be of a good design. Secondly, it should be connected up properly. We now turn on the filaments of the tubes to their proper brilliancy which varies with the different types of tubes used. With the tickler or amplification dial or pointer turned to zero, we next move the tuning dial or dials slowly from left to right listening for signals. If no signal is heard, the tickler or amplification dial should be advanced

slightly from the zero position on the dial, and again the tuner dials should be turned slowly over their range. Should a signal be heard but faintly, the tickler should be advanced as far as possible without causing a hissing sound, which indicates that the tube has passed the point of greatest regeneration and is oscillating. These oscillations produce the same effect as another transmitting station sending out signals. They are heard by other receiving sets and are known as "birdies." The tickler should be turned back until the signal is cleared up or even a little past that point, for a too strong signal may cause the detector tube to break over and oscillate again.

The best way to make sure your detector tube is not disturbing others is to plot a tickler diagram. This is done as follows: after the tubes are lighted to the proper brilliancy, the tuner is placed at zero and the tickler is advanced until a click is heard. At this point the tube starts to oscillate. Then mark down the readings in two columns, one marked tickler and the other, tuner. Next the tuner is advanced one large division, and again the tickler is advanced until the click is heard, and these readings should be taken. This procedure is carried out over the entire tuner scale, and it can readily be seen that, with the use of this set of readings, one will be able to set the tickler or amplification pointer to a division just below the oscillating point.

Now it is possible that the click or breaking point of the tube may not be heard by merely turning the tickler. If so, the operator should tap the antenna post with his finger, and, when the tube is not oscillating, he will hear only a single click. As soon as the tube starts to oscillate, the operator will get a click when he touches the antenna post, and another click when he takes his finger from the post, or in other words a double click. Now it is not advisable to do this during the program period but the experiment should be tried during the day when there is least chance of disturbing others.

The ideal regenerative receiver and antenna will have what is termed a flat tickler curve. By this we mean that it will be possible to put the tickler at a certain point and turn the tuner any place and be at maximum regeneration without causing oscillation. If the set has this characteristic, much less trouble tuning-in stations without annoying others will be experienced.

YOU DON'T HAVE TO DISTURB THE NEIGHBORS

THE reception of signals at "zero beat" causes more interference than any other method of tuning and should be discouraged. The results obtained are not at all satisfactory unless one juggles the vernier or tickler dial. Each movement of either dial causes the detector tube to transmit weird signals and those in turn are heard by all local listeners. Again the varying strength of signals may cause the detector tube to flop in oscillation from one side or the other and ruins the program not only of others near by, who may be listening, but of the person tuning the set as well. The crystal type of radio receiver, as well as those having one or more stages of radio-frequency amplification, cause no disturbance of this kind.

Let me say that it is possible, with the co-operation of all radio listeners, to clear the air of "birdies," or the "wail of lost souls," if each and every one of us will take precaution to see that our detector tubes are not oscillating. To do so demands that we all to the best of our ability observe the golden rule.

A GOOD SINGLE DIAL REFLEX

LIVE manufacturers and dealers in all parts of the country have realized the sales possibilities of RADIO BROADCAST'S Knock-Out Series. They know we have built up tremendous demand for non-radiating receivers of above average quality. They know that there is a ready market for any receiver we recommend to our readers and some of them have been working night and day to produce improvements for us. One such receiver will be described in our December number by Mr. John Clyde Davidson who is Consulting Engineer for a number af Radio manufacturing companies.

QUERIES ANSWERED

How Can I Build a Crystal Receiver?	T. S. L., Flushing, L. I., N. Y.
Will You Explain the Correct Use of Solder?	C. P., Philadelphia, Pa.
How May Additional By-pass Condensers be Used in the Roberts Circuit?	M. C. G., London, England
Will You Publish the Formula for Converting Wavelengths in Meters, into Kilocycles, and Vice Versa?	A. L. L., Birmingham, Ala.
What Stations May be Depended Upon as an Aid in Calibrating Receivers and Wavemeters?	Wm. T. M., Brooklyn, N. Y.

THE CONSTRUCTION OF A CRYSTAL RECEIVER

IN THIS day of "supers," neutrodynes and reflexes, we still receive inquiries for construction data for the simple crystal receiver. And rightly so, for this marks the inclusion of another fan within the ranks of radio.

One of the most simple receivers consists of an antenna, ground, tapped inductance coil, crystal, fixed condenser, variable condenser, and phones.

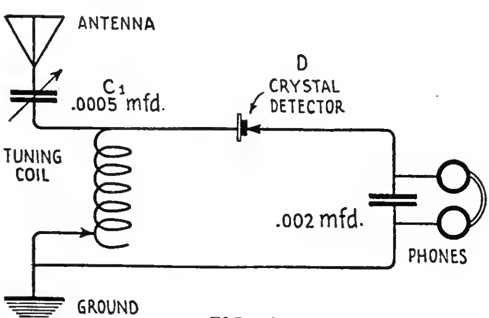


FIG. I

This set will not operate a loud speaker. See Fig. 1.

The coil is wound as follows: On a tube $3\frac{1}{2}$ inches in diameter and 6 inches long, wind 120 turns of No. 20 DCC wire tapped every ten turns. This is the only part that has to be home-made. A crystal detector could easily be made, but at the prevailing prices it is cheaper and more convenient to buy one.

The parts may be mounted upon a panel or upon a flat board. Use bus bar wire for connecting and solder all joints. The several diagrams and sketches show the details of construction. See Fig. 2.

Roughly, this receiver will not have a range to exceed 25 miles and is primarily intended for use in a large city boasting several local broadcasting stations.

To operate this crystal receiver, connect the antenna, ground and phones to their respective binding posts and set the tap switch upon one of the taps, then, slowly rotating the condenser dial, adjust the point of the detector catwhisker upon the crystal until a sensitive spot is found. To select a station having a different wavelength, it is only necessary to readjust the tap switch and condenser setting. With a little practise the operation of this receiver is easily mastered.

SOLDER—AND HOW TO USE IT

IN PRACTICALLY every receiver made, solder is used to insure a permanent and electrically perfect connection between wires. Soldering, by the way, may be considered a form of brazing. The forms of flux that are used to clean and prepare the wires for joining are deserving of more thought than the constructor sometimes gives.

For radio use, the best solder is "half and half," that is, half tin and half lead. In bar form it is unwieldy. In strip form, solder is most easy to use.

Hard solder, having an unequal proportion of lead and tin, is quite difficult to use. A great amount of steady heat must be used to insure a perfect joint. In radio wiring where a small iron is generally used it is hard to get steady heat because an iron of this size loses its heat very rapidly.

Good soldering cannot be done unless the soldering iron is clean. Often, when the iron is left in the flame too long, it becomes red hot. When it cools it is covered with a black oxide coating. To remove this coating and clean the iron, place it in a vise and file it until it is bright, then wipe it upon a chunk of sal ammoniac. This restores the iron to its original brightness. Apply solder to the tip until it is entirely covered. The iron is then ready to use.

Do not put the tip of the iron in the flame as this will burn the part which does all the work. The rear part of the iron should be placed in the flame and since it is larger, it will retain the heat longer.

There are three classes of soldering fluxes: dry, paste, and fluid. Powdered resin may be mentioned under the first class, but is not especially good, for the resulting joints are caked, dirty, and imperfect.

Paste fluxes are good when used intelligently. Very little flux is necessary for a good connection. Flux is a cleaning agent and when a heated iron is brought near, the flux melts and flows over the

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A highly desirable accessory for TRF-5, as illustrated . . . $25.00

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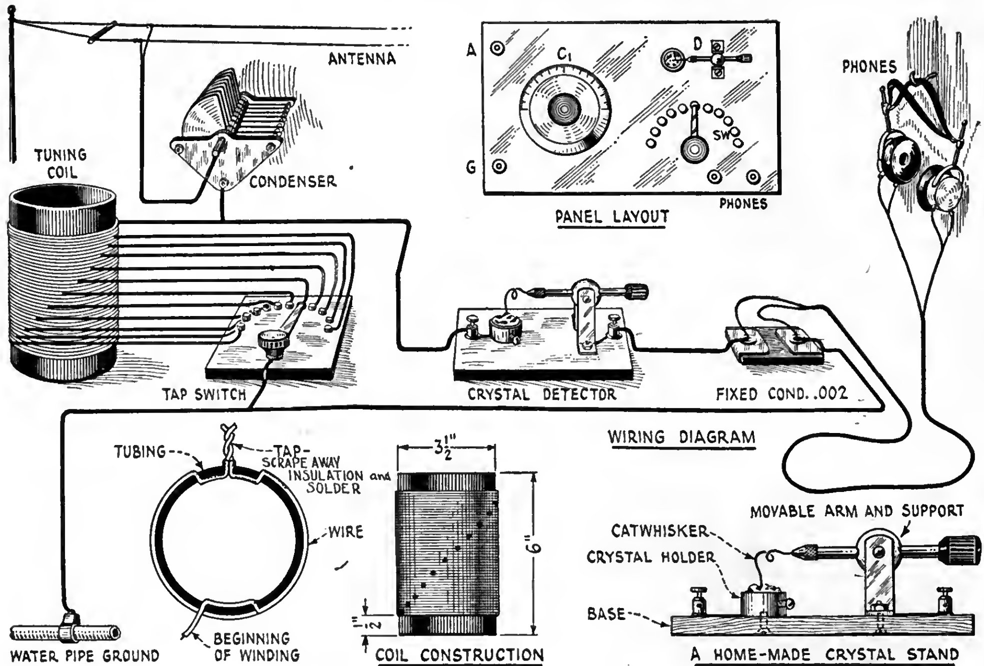

FIG. 2

metal and other parts. When too much is used it veritably flows all over the parts and in some cases, when one is soldering switch taps, this spreading solder and flux forms a leak between adjacent taps great enough to impair the efficiency of the receiver.

Liquid flux is also generally used with success when not too much is applied to the joint. When used in profusion it boils and spatters over adjacent parts causing current leaks, etc.

The most common form of liquid flux may be prepared by "killing" muriatic acid. This "killing" process is accomplished by immersing slices of zinc in the muriatic acid and letting it remain until all the bubbles due to the chemical action have disappeared.

Another liquid solution that has proved worthy may be prepared by mixing a quantity of powdered resin in alcohol to a consistency resembling molasses.

Some of our readers have had difficulty in soldering wire having an enamel insulation. It seems that the trouble has been caused by some of the enamel remaining upon the wire and preventing a perfect connection.

One of the easiest ways to remove the enamel from wire is as follows: Fill a thimble with alcohol. Heat the tip of the wire to be cleaned in a flame until it is cherry red, then quickly plunge it into the alcohol and remove. Result—a clean wire easily soldered.

KILOCYCLE-METER CONVERSION TABLE

THE Department of Commerce specifies radio station assignments in both kilocycles and meters. The tendency of radio engineering practice is to use and express frequency in kilocycles rather than wavelength in meters. "Kilo" means a thousand, and "cycle" means one complete alternation. The number of kilocycles indicates the number of thousands of times that the rapidly alternating current in the antenna repeats its flow in either direction in one second. The smaller the wavelength in meters, the larger is the frequency in kilocycles. The numerical relation between the two is very simple. For approximate calculation, to obtain kilocycles, divide 300,000 by the number of meters; to obtain meters divide 300,000 by the number of kilocycles. For example, 100 meters equals approximately 3000 kilocycles, 300 m equals 1000 kc, 1,000 m equals 300 kc, 3,000 m equals 100 kc.

For highly accurate conversion the factor 299,820 should be used instead of 300,000. The Department of Commerce has prepared a table, which may be obtained upon application. The table is based on the factor 299,820, and gives values for every 10 kilocycles or meters. It should be particularly noticed that the table is entirely reversible; that is, for example, 50 kilocycles is 5996 meters, and also 50 meters is 5996 kilocycles. The range of the table is easily extended by shifting the decimal point; for example, one can not find 223 in the first column, but its equivalent is obtained by finding later in the table that 2230 kilocycles or meters is equivalent to 134.4 meters or kilocycles, from which 223 kilocycles or meters is equivalent to 1344 meters or kilocycles. Briefly, the formula for computing kilocycles and wavelength is as follows:—

For finding the wavelengh, when the number of kilocycles is given $\lambda = \frac{V}{KC}$

For finding the number of kilocycles when the wavelength is given $KC = \frac{V}{\lambda}$

KC = Kilocycles
λ = Wavelength in meters
V = Velocity of electromagnetic waves (300,000 or, to be exact, 299,820)

Another step ahead!

ULTRADYNE
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SUPER-HETERODYNE
MODEL L-2

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THE new Ultradyne, Model L-2 surpasses all conceptions of sensitivity and selectivity—represents the peak of Super-Heterodyne engineering skill.

To the "Modulation System" which has previously made the Ultradyne famous, regeneration is added in Model L-2. The result is ultra-sensitivity, never before thought possible. The regeneration of infinitely weak signals produces tremendous amplification.

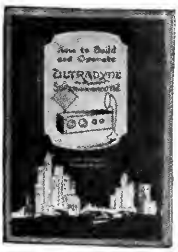
Selectivity is so high and amplification so strong that distant stations can be tuned in through local stations and put on the loud speaker.

This use of regeneration is the latest development of R. E. Lacault, A.M. I.R.E., Consulting Engineer of this Company, and formerly Radio Research Engineer with the French Signal Corps Laboratories, since his perfection of the "Modulation System" which is used exclusively in the Ultradyne Receiver.

The Model L-2 Ultradyne compels so complete a revolution in all previous ideas of Super-Heterodyne performance, that you can only comprehend its unusual selectivity, sensitivity, volume and range by operating this wonderful receiver.

Write for descriptive circular

PHENIX RADIO CORPORATION
5-7 Beekman Street NEW YORK



Send for 32-page illustrated book, giving latest authentic information on drilling, wiring, assembling, and tuning the Model L-2 Ultradyne Receiver.

50c

Ultradyne Kit

R E L

Consists of one low loss Tuning Coil, one low loss Oscillator Coil, one special low loss Coupler, one type "A" Ultraformer, three type "B" Ultraformers, four matched fixed Condensers.

The Ultraformers are new improved long wave radio-frequency transformers, especially designed by R. E. Lacault, Consulting Engineer of this Company and inventor of the Ultradyne.

To protect the public, Mr. Lacault's personal monogram seal (R.E.L.) is placed on all genuine Ultraformers.

Ultraformers are guaranteed so long as this seal remains unbroken.

$30

A BY-PASS CONDENSER FOR THE ROBERTS RECEIVER

A DISTINCT addition and improvement to the Roberts circuit has been made by the placing of a .00025 mfd. condenser across the secondary of the reflex audio transformer and the C battery. With this arrangement, a by-pass is provided for the radio-frequency currents and, it is roughly estimated, the efficiency of the receiver has been improved by as much as 60 per cent. The value of condenser given here will undoubtedly vary with the type of transformer used, etc., so it is well to experiment with several values to select the one being found most successful. Fig. 3 shows diagrammatically, the position of this condenser in the "first tube" circuit.

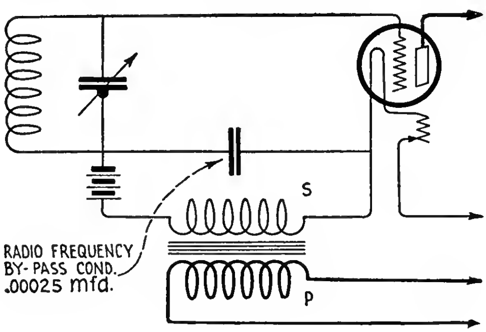


FIG. 3

STANDARD FREQUENCY STATIONS

AS A result of measurements by the Bureau of Standards upon the transmitted waves of a limited number of radio transmitting stations, data is given in each month's *Radio Service Bulletin* on such of these stations as have been found to maintain a sufficiently constant frequency to be useful as frequency standards. There may be many other stations maintaining their frequency just as constant as these, but these are the only ones which reached the degree of constancy shown among the stations upon whose frequencies measurements were made in the Bureau's laboratory. There is, of course, no guaranty that the stations named below will maintain the constancy shown. As a means of maintaining constant frequency, the highpower low-frequency alternator stations listed below have speed regulators. Most of the broadcasting stations listed use frequency indicators (one-point wavemeters) and maintain a maximum deflection of the instrument on the frequency indicator throughout the transmission. These broadcasting stations, with rare exceptions, vary not more than 2 kilocycles from the assigned frequency. The transmitted frequencies from these stations can be utilized for standardizing wavemeters and other apparatus by the procedure given in Bureau of Standards Letter Circular No. 92, "Radio signals of standard frequencies and their utilization." A copy of that letter circular can be obtained by a person having actual use for it, upon application to the Bureau of Standards, Washington, D. C.

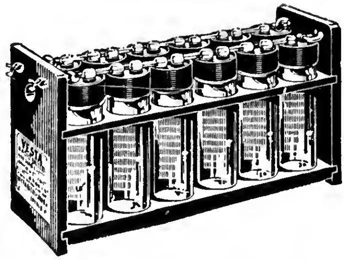
Station	*Owner*	*Location*	*Assigned frequency (kilocycles)*	*Period covered by measurements, months.*	*No. of times measured.*	*Average deviation from assigned frequency.*	*Greatest deviation from assigned frequency since July 15, 1924*
						Per cent.	*Per cent.*
NSS	U. S. Navy	Annapolis, Md.	17.50	12	86	0.2	0.1
WGG	Radio Corp. of America.	Tuckerton No. 1, N. J.	18.85	12	102	0.2	0.1
WII	Radio Corp. of America.	New Brunswick, N. J.	22.04	11	85	0.2	0.1
WSO	Radio Corp. of America.	Marion, Mass.	25.80	12	90	0.3	
WWJ	Detroit News.	Detroit, Mich.	580	12	41	0.1	
WCAP	Chesapeake & Potomac Tel. Co.	Washington, D. C.	640	11	58	0.1	0.0
WRC	Radio Corp. of America.	Washington, D. C.	640	8	40	0.1	
WSB	Atlanta Jnl.	Atlanta, Ga.	700	11	52	0.1	
WGY	General Elec. Co.	Schenectady, N. Y.	790	14	89	0.2	
WBZ	Westinghouse Elec. & Mfg. Co.	Springfield, Mass.	890	4	9	0.0	
KDKA	Westinghouse Elec. & Mfg. Co.	E. Pittsburgh, Pa.	920	11	116	0.1	0.1

New Equipment

THE FRANCE SUPER-CHARGER

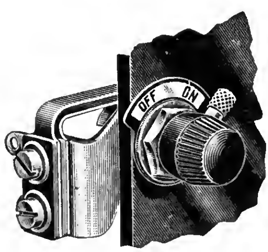
A multi-duty charger for both A and B batteries. A distinctive feature is its ability to charge up to 120 volts of storage B batteries in series. Rectification is by means of an improved vibrating unit with a positive action which eliminates sticking and burning of the contacts. Made by The France Manufacturing Company, Berea Road and W. 104th St., Cleveland, Ohio

VESTA B BATTERY

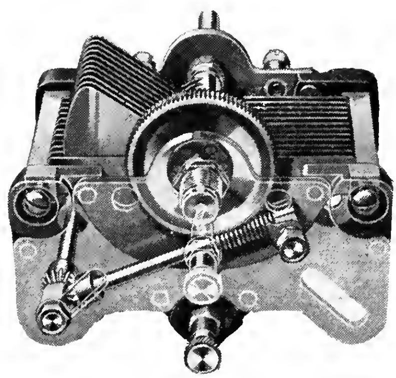


A B storage battery for radio use of sturdy construction. The elements are enclosed in heavy glass jars of ample size allowing room for plenty of electrolyte. The wiring is so arranged that they can readily be charged in multiples of 12, 24 or 48 volts. Made by the Vesta Battery Corporation, Chicago, Illinois

MIDGET BATTERY SWITCH



A very compact and useful unit for the radio set. The contact springs are of hard rolled bronze and are insulated from the metal frame. Only one hole is necessary for panel mounting. Made by The Yaxley Mfg. Co., 217 North Desplaines St., Chicago, Ill.



AMERICAN BRAND CONDENSER

A low loss condenser of good mechanical design and workmanship. It is made from a heavy stock of brass and the plates are spaced very evenly. It has a worm drive vernier with a ratio of 100 to 1 which insures accurate tuning. Made by the American Brand Corporation, 8 West Park St., Newark, N. J.

THE BRANDOLA

A six-tube, one dial receiver which gives very satisfactory results. Its simplicity of control is noted in that you have only one tuning dial to operate. Resistance-coupled amplification insures good tone quality. Made by The J. F. Brandeis Corp., 36 Oxford St., Newark, N. J.

★ The FADA Neutrola Grand

new beauty, new perfection in Radio

An EXQUISITE instrument. Encased in beautifully finished genuine mahogany. A gem of the cabinet designer's art. A piece of furniture that will adorn any home.

Here in this new FADA Neutrodyne is a real achievement in receiving beyond anything you ever heard. Wonderful naturalness of tone. The high C of the coloratura soprano and the lowest bass of the human voice are reproduced precisely as sung. In selectivity the FADA Neutrola is remarkable.

FADA

FADA Neutrola Grand

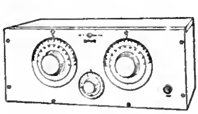
The de luxe five-tube FADA Neutrodyne, with self-contained loud speaker. Receiver and cabinet in genuine mahogany, artistically decorated with wooden inlay. Ample space for all batteries and charger. Drop desk lid that hides receiver when not in use. Price, exclusive of tubes and batteries, $295.

Ease and simplicity of tuning make it the ideal receiver for all the family.

The FADA Neutrola Grand is the finest of the complete line of FADA Neutrodynes, which includes a model to suit every taste, every radio requirement, every pocketbook. Three, four and five tube FADA Neutrodyne receivers in plain or de luxe cabinets are now available at your dealer's. See them today and make your selection. You will never regret buying a FADA.

You have a range from $75 to $295 from which to select—six models, each extraordinary in results; each a remarkable value.

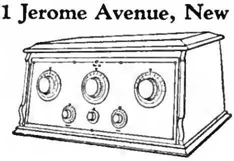
F. A. D. ANDREA, Inc.
1581 Jerome Avenue, New York



FADA Neutro Junior
No. 195
Three-tube Neutrodyne. A wonderful performer. Price (less tubes, batteries, etc.) $75.

FADA
Radio

LICENSED BY INDEPENDENT RADIO MANUFACTURERS, INC.
NEUTRODYNE
REG U S PAT OFF
HAZELTINE PATS PAT MARCH 27 1923 AND APRIL 1, 1924 NOS 1450080 AND 1489228
OTHER PATENTS PENDING
F A D ANDREA INC. 1581 JEROME AVE. N.Y.C.



FADA Neutroceiver
No. 175-A
Mahogany cabinet. Inclined panel and roomy battery shelf. 5 tubes. Price less tubes, batteries, etc.) $160.

★ Tested and approved by RADIO BROADCAST ★

Among Our Authors

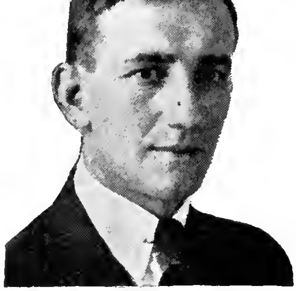
MARK SULLIVAN is a Washington correspondent for the New York *Herald-Tribune* and contributor of regular articles to the *World's Work.* His political pronouncements are read nationally with much interest because they are readable and authoritative.

JULIAN KAY is an old-time Middle West amateur who played with radio as soon as he was able to climb his grandfather's barn. He has been a ship operator for the Marconi Company, Kilbourne and Clark, the Radio Corporation, and the Shipping Board. During this "brass pounding" career he received three sos calls.

HANSCOM, JR.

ALLAN T. HANSCOM, in addition to being a graduate electrical engineer and radio merchandiser, is president of the Chamber of Commerce at Woonsocket, Rhode Island. He writes that he is a good Kiwanis member, a rather inferior tennis player, and as the final thrust, that he hopes to help elect Coolidge if he lives through the world's series. The photograph shows Hanscom, Jr., in a home made automobile.

FRED JAMES is a Canadian newspaper man whose typewriter and home are now in Ottawa. He was an infantry officer in the Canadian forces overseas and after being wounded, was sent back to France as official Canadian war correspondent. His despatches were later published in book form by the Canadian Government under the title *Canada's Triumph.* Mr. James admits that he combines an amateur interest in radio with his writing. Well, it can be done.



FRED JAMES

ERLE H. SMITH

"RADIO came hard in the flying days at Sacramento and San Diego in the training days of the war," writes Erle H. Smith, from the office of the Kansas City *Journal-Post* where he is now features editor. Although he is pretty busy during the day, he finds time at night, he says, to listen to good radio entertainment from San Juan to Los Angeles on his five-tube receiver.

T. O. SHEARMAN

THOMAS O. SHEARMAN is a consulting radio engineer for various radio firms. Just now he is working on the manufacture of a new resistance unit. In the past he has done testing and experimental work for the Western Electric Company, the Lowenstein Radio Company, and the Electrose Insulator Company. He makes his home at Kew Gardens, Long Island.

A. K. PHILLIPI

A. K. PHILLIPI is now an engineer with the Westinghouse Company. For a span of four years he served as an apprentice machinist in the Navy. And when the Pittsburgh fogs cloud things up a bit, he writes that he finds time to rough it in the wilder or more wooded sections of Pennsylvania.

"Are those Tubes Genuine?"

The question is heard at every radio counter: "Is it a genuine Radiotron?" Almost every dependable manufacturer uses genuine Radiotrons in his sets. Everyone who builds his own knows enough about radio to know that nothing else but the genuine will do. And the man who replaces used-up tubes in his set knows that to get the same performance, he must have the same tubes—genuine Radiotrons only. So everybody asks "Is it genuine?" And asks to see the marks that prove it—the name "Radiotron" and the "RCA" mark.

All Radiotrons Now Reduced to $4.00

It isn't a genuine WD-11 unless it's a Radiotron.

It isn't a genuine WD-12 unless it's a Radiotron.

It isn't a genuine UV-199 unless it's a Radiotron.

It isn't a genuine UV-200 unless it's a Radiotron.

It isn't a genuine UV-201-a unless it's a Radiotron.

Radio Corporation of America

Sales Office: Suite No. 311

233 Broadway; New York 10 So. La Salle St., Chicago, Ill. 433 California St., San Francisco, Cal.

RCA

This symbol of quality is your protection

Radiotrons

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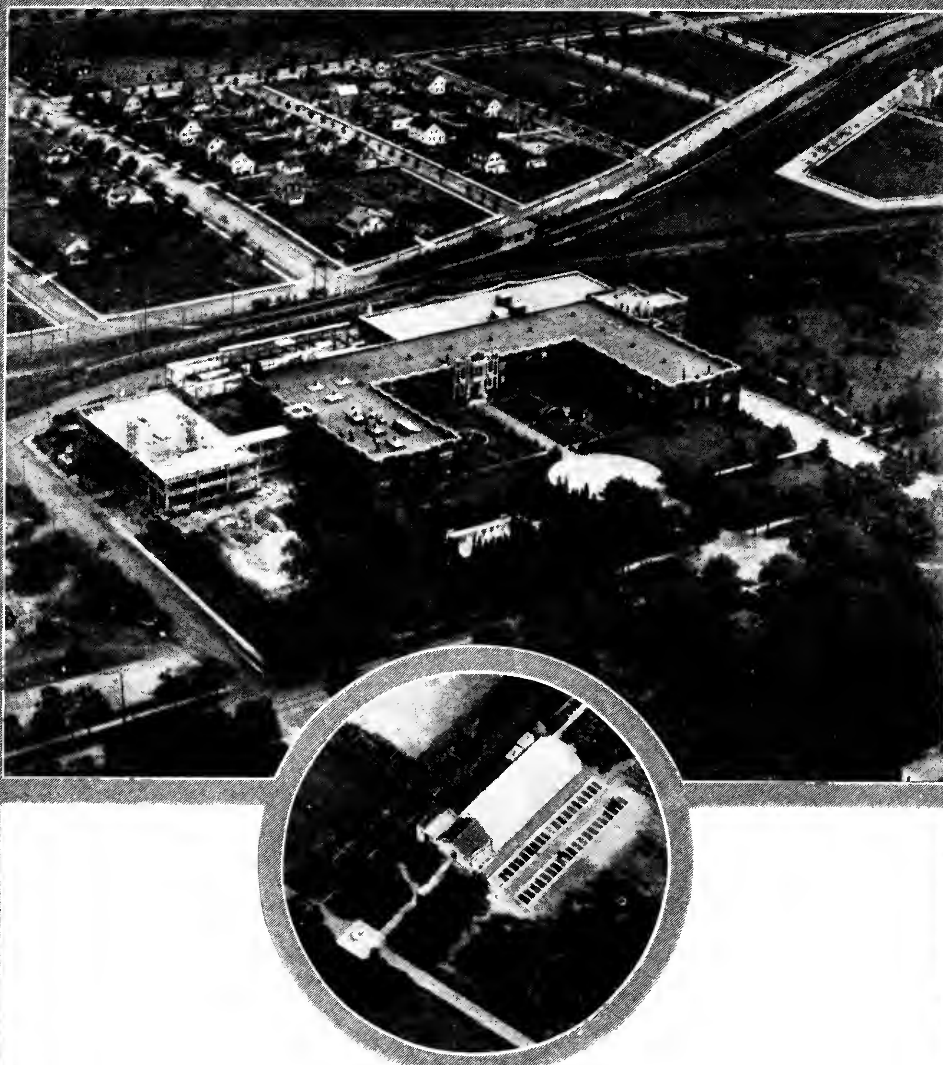


"G.H.Q." FOR THE INTERNATIONAL RADIO BROADCAST TESTS

The offices and grounds of Doubleday, Page & Company, at Garden City, Long Island, where RADIO BROADCAST *is published. The circle shows the Laboratory of the magazine where the transoceanic signals will be received. Special lines of the telegraph companies lead to the laboratory, where messages to the magazine, telling of successful reception of the foreign signals from all over the country will be received and tabulated. The results will then be sent at once by radio to London. The Radio Corporation of America has made a special control connection with Radio Central at New York. A key in the Laboratory will control the transatlantic telegraph circuit during the tests*

RADIO BROADCAST

Vol. 6, No. 2 December, 1924

Making Wireless History With De Forest

Thrilling Days of Trial and Error in the True Pioneer Wireless Times—A Ten-Kilowatt Set that Sent Four Miles—Thrills for the Natives at the St. Louis World's Fair—Twenty Years of Wireless in Retrospect

By FRANK E. BUTLER

Former Chief Assistant to Dr. Lee De Forest

TO BE able to look back twenty-odd years, practically to the very inception of radio, and view the development of this wonder art—through personal experiences gained from gruelling years of hopes, disappointments, and successes, is a privilege that only a few of us can share with Dr. Lee De Forest, the famous radio inventor.

Surely, the most enthusiastic radio fan cannot realize the exceptional thrill which is now mine as I listen-in on my radio receiver and compare its wondrous achievements to those of the struggling, experimental days when I assisted Dr. De Forest in his elementary pioneer work; in the building of his first few "audion bulbs", and shared with him the marvel of listening-in for the first time to a wireless telephone.

MR. BUTLER IN 1904

A photograph of the author, taken by the official photographer of the St. Louis World's Fair, where he and Dr. De Forest were exhibiting the marvels of wireless

For radio is not, as many believe, a new thing. Its development has passed through the crucible of a thousand failures with their resulting disappointments. Its progress was constantly blocked by unknown scientific laws against which we pitted our puny knowledge. Every secret extracted from Nature was gained by relentless tests carried on frequently without funds and often without adequate laboratory equipment or tools, and with comparatively little encouragement from humans or from Nature. But always there was the inspiring guidance of "Determined De Forest."

It was in the early spring of 1904 when, with no more electrical knowledge than that possessed by the average telegraph operator, I gave up a promising position as train dispatcher on the New

York Central to take up the then new work of wireless telegraphy. A short time before this, Marconi had startled the world by successfully sending and receiving telegraphic signals over a short distance without wires. De Forest, who was then a young student at Yale, took up research work in this unknown field of "wireless," and thereby became one of the first American experimenters to turn his entire attention to this work. When I joined him, practically all of my friends and relatives with the exception of my father, chided me and advised against the move. My father thought best to let me choose my own career, and while he never lived to listen to modern radio, he was familiar with and proud of the achievement I had made up to the time he passed away. The railroad position carried a large salary with abundant opportunity for advancement, while my new "job" paid only a meagre amount and offered no apparent assurance of a future. The idea of communicating through space without wires was at that time considered fantastic, an idle dream, an impossibility, a game for fools. Many thought it was a fake.

WIRELESS STARTLES THE WORLD'S FAIR IN 1904

SO, AFTER "burning my bridges behind me," I went to St. Louis and joined De Forest at the World's Fair where he was planning the first public wireless exhibit. Immediately, my troubles began.

Due to some slip in the arrangement, I found, upon my arrival, that our "financier" had decided upon another man for the job, and the company could not afford to pay two employees. After some scheming on ways and means, the two of us decided to double up on the salary question, and in that way we both stayed. Within a week or two I was chosen as special assistant to De Forest because I could telegraph while he could not. From that time on, and for many years, I was perhaps closer to him in his interesting work than any other of his employees. Subsequent events and severe trials in which I stood by him through thick and thin convinced me that he appreciated my efforts. Others of his employees likewise never deserted him through even his most crucial periods. He called us his "Old Guard" and we were as faithful as Napoleon's followers. Our working mottoes were, "Never say die," and "You can't stop a Yank." We never accepted failure as a finality, but tried to find out why we met it, and then attempted to overcome it.

"The Man Is Crazy"

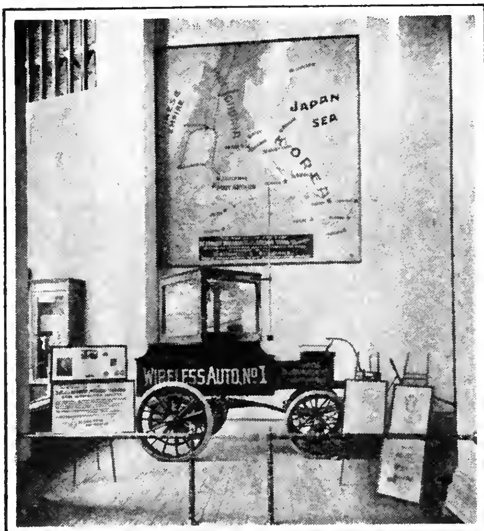
At least that is what almost everyone thought of Dr. Lee De Forest back in those early pioneer days, more than twenty years ago. Then, you could easily count all the men in the country who even pretended to know anything about wireless. No one of the few who were working with wireless then, knew whether a set carefully put together would work at all, and how far the signals could be heard was nothing but a guess. Transmissions of a hundred miles or more were hailed as remarkable. Present-day radio listeners are quite prone to think of radio as nothing more than telephonic broadcasting. But before the wireless telephone, came tremendous amounts of hard, sometimes discouraging, but always fascinating and essentially romantic work. Dr. De Forest is one of those pioneers. Mr. Butler's memories of the early days are mightily worth reading, since he not only saw the early wireless drama, but himself acted in it.—THE EDITOR.

At that time there was, of course, no radio public, and the range of wireless was only a few miles. The sending and receiving instruments were unbelievably crude, resembling in no way the marvels of today. Messages were sent at the snail-like pace of a few words per minute, in the dots, spaces, and dashes of the Morse code, instead of the International code which is now generally used. Sending music or talking by wireless was then undreamed of. There were many mountainous obstacles to meet and conquer before we even had the vision of a wireless telephone, which was the forerunner of radio.

DE FOREST'S CHANGES IN THE NEW ART

ONE of the first changes to be accomplished by De Forest was to use a headphone for receiving instead of the telegraph sounder used by Marconi in early experiments. The first receiving device was called a "coherer" and was made of a glass tube filled with metal filings. These filings "cohered" when the ether impulse passed through them, thus making an electrical circuit which caused the sounder to click. This method was extremely crude and inaccurate, and the device had the unpleasant habit of occasion-

ally failing to "de-cohere." In other words it would not go back to normal after the signal had passed through. It was sometimes necessary to tap the tube with a pencil in the left hand while writing with the right.



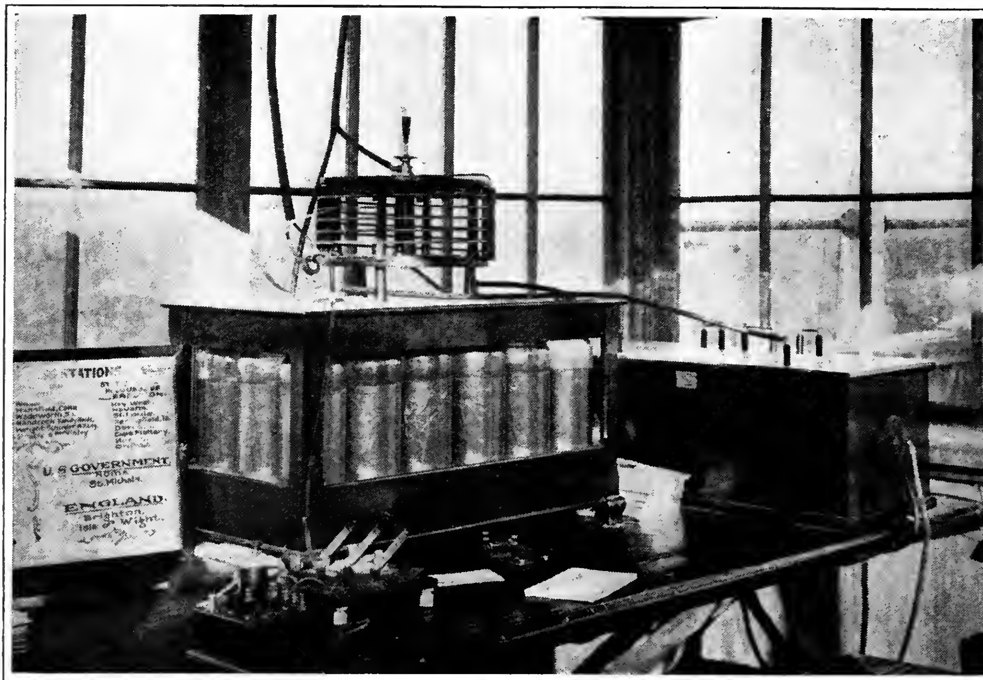
Short words we guessed at, while long words were so badly disjointed that we figured those out as a child does a rebus puzzle.

The apparatus for sending was a Ruhmkorff induction coil with a vibrator on one end. Direct current was used in the coil and the vibrator converted it into alternating current of slow oscillations as compared with those used to-day. The power used then to send six miles would to-day send almost six thousand.

One of Dr. De Forest's earliest achievements was to produce a transmitter operated by alternating current of high frequency. This gave a strong firm spark and signal far superior in carrying quality, and far easier to read than the thin weak notes from an induction coil. The transformer coils were specially wound, and near at hand were placed a "spark gap" and "helix" or tuning coil, and thus "tuning the signals" was brought into reality. Then we started to talk about certain waves of different lengths, etc., and we used the tuning fork as an illustration. Mathematics had no place in the embryo radio of those days and it was many years before we learned how to measure the wavelengths and use such complicated and fearful sounding terms as of meters, kilocycles, etc. Leyden-jar condensers of various kinds of hookups were placed across the "spark-gap," and we noted the phenomenon of changing the pitch or note of the spark as we changed the capacity of the jars. We found that this new form of transmitter easily outranked the old induction coil, so a decided step in advance was made. Little did we then think that this was the beginning of the rocky, curved road over which radio was to pass before reaching its goal of to-day.

WIRELESS AT ITS FIRST WORLD'S FAIR

The De Forest tower—300 feet high—was a remarkable feature of the fair and was illumined at night with great numbers of incandescent lights. The insert shows a wireless automobile which was equally in style for the period as far as radio and automotive construction was concerned



PIONEER EQUIPMENT

A close-up of the De Forest transmitting equipment on top of the wireless tower at the World's Fair. Note the anchor gap at the left of the direct connected helix, which, by the way, contains the open zinc spark gap

THE "GOO" DETECTOR

MANY experiments were carried on to find a more sensitive receiver than the coherer. We knew nothing about "rectification" then. There were no text books on the subject, nor any radio editors to write to for advice. We were merely electrical eccentrics playing with a dream, so one guess in the way of an experiment was usually as good as

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EAGER CROWDS SEE MESSAGES FLASH FROM WIRELESS TOWER

Post-Dispatch Sending Station for World's Fair News Fairly Sings as Words Leaps Across the Copy—Visitors Attracted Manifest Keen Interest.

WORLD'S FAIR GROUNDS,
Via De Forest Wireless.

Flashing messages through space from the Fair to the office of the Post-Dispatch continues to be the wonder of Fair visitors and crowds watch the process from morning until night.

The flash of 20,000 volts every time the operator presses his key is to them a thing of fascination. Then they turn from it to look from the great De Forest tower out eastward across the large city, but they see no sign of the message which the clicking instrument is sending out there through space.

Sometimes they stop the operator at his work to ask him if it is really so. They shake their heads in amazement when he answers "yes," and explains that in the Post-Dispatch office another instrument is ticking in response to his, and thus carrying Fair news to the newspaper and the world. The loud buzzing of the powerful instrument surrounding the operator 200 feet above the ground in the De Forest tower does not prevent the visitors from crowding about him.

It is so loud that the operator must keep his ears full of cotton. It fairly deafens visitors and sending them away with a headache if they stay too long, but nevertheless they stay, for the power of the mystery is very great.

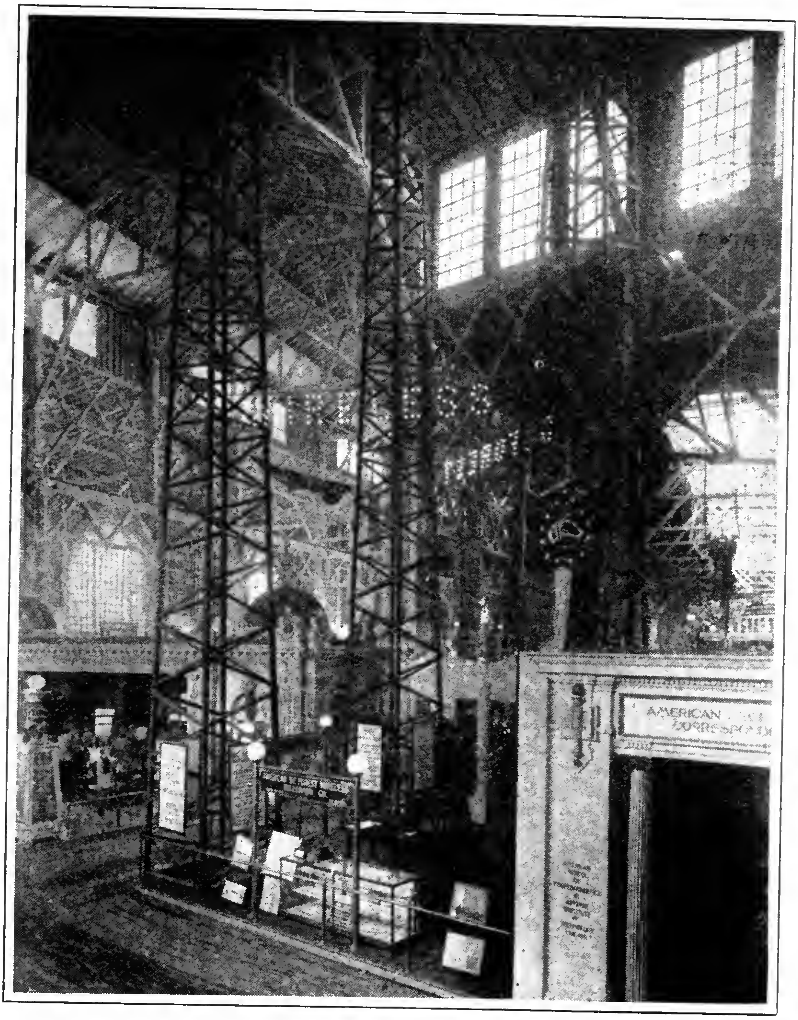
This buzzing is caused by the powerful electric spark which the operator's key releases and corresponds to the click of the ordinary wire telegraph instrument. The dots and dashes are so audible that operators for telegraph companies and the police and fire departments anywhere within two blocks of the wireless tower amuse themselves with reading the wireless messages as they are buzzed off by the sending operator.

—Published in the St. Louis Post-Dispatch during 3rd Week of June, 1904.

another. One day, while working on receivers, it was discovered that a salvy mixture of various ingredients reproduced the signals in the headphone. The "discovery" was thoroughly tried out but found lacking in any definite merit, although it did get as far as to receive a name. It was called the "goo" receiver, and I believe that somewhere in the archives of the Patent Office may be found a formal application for a patent made for it by Dr. De Forest. Finally the electrolytic receiver was introduced. This was such an advance over anything previously introduced that it seemed to be the height of perfection. It consisted of a small glass cell containing a dilute solution of caustic potash and water which formed one anode of the circuit. Into this solution was immersed a cathode point, and the incoming wave was rectified by electrolytic action. Fessenden employed a fine wire coated with silver which was dipped into nitric acid to burn off the coating and make a fine whisker point. De Forest used a different type terminal called the "spade electrode" because of the shape of the terminal. This was found to be both practical and sensitive and not subject to "burning off points" in the middle of a message as was that involved in the Fessenden principle. In this circuit was introduced the potentiometer, a name coined for radio work. This set also contained the first "variable condenser." Instead of the movable plates so common to-day, we used a small brass tube split in halves lengthwise and rotated one half within the other without moving them backward or forward. We knew nothing about "measuring" capacity. Either our experiment worked or it didn't. If it failed, then we would "change things" until it did work.

WHAT TO NAME THE CHILD?

IT WAS always characteristic of De Forest to call every new item discovered by a simple homely name which was significant of the act it did or the thing it resembled. Most of the names coined by him many years



THE EXHIBIT

Of the "American De Forest Wireless Telegraph Company" at the St. Louis World's Fair in 1904. A sample transmitting and receiving set is installed in the booth. Its noisy crackle could be heard for great distances

ago, are still used in radio to-day. Some of these are the "fan" antenna, the "helix," the "spade" electrode, the "pancake" tuner, the "spider-web" tuner, the "wing" (now called plate), the "grid" of the audion bulb; the A and B battery; and audio and radio frequency.

The first transmitters made were of 4-K.W. power. They were soon supplanted by a 10-K.W. set. It was this latter size that was used on the large 300-foot steel tower erected on the World's Fair Grounds at St. Louis. Two spacious elevators carried visitors to the top of this observation tower where the wireless instruments were installed. Many amusing incidents happened. One day, a lady desiring her full share of information, listened intently to our explanation of wireless and then bluntly told me in front of the crowd that the whole thing was a fake. She agreed that we "sent without wires," but she insisted we did this by using a silk thread instead of a wire between the two stations, thus making it "wireless." Many persons would go outside and look up to see if anything was visible from the top of the mast when the signals left.

From this tower we transmitted daily news to the St. Louis *Star* and the *Post-Dispatch*, a distance of five miles. Thus was established the first newspaper radio service, and the reprint on page 214 from the *Post-Dispatch* during the third week of June, 1904, is the first radio news message to be flashed through the air and published in a newspaper upon a predetermined and established schedule.

DR. LEE DE FOREST

In a corner of his laboratory. This picture was taken years after the others which appear with this article. Dr. De Forest is standing before one of his vacuum tube telephone transmitters which he designed to operate from the ordinary 60 cycle lighting current

WIRELESS A MIRACLE—OVER FOUR MILES

AT NIGHT the tower was illuminated by thousands of electric lights which could be seen for many miles. In addition to this station, another exhibit was maintained in the Electricity Building and from both places we demonstrated "wireless" to endless streams of curious people. In an adjoining booth was displayed "Wireless Auto No. 1," which was the very first wireless automobile. Its range of reception was only a few blocks but it always created much interest whenever it was driven about the streets or viewed at its exhibitor's stand. Its design of chassis in comparison with present-day automobiles shows its antiquity.

Not content with the honors the 10-K.W. station had won for him, De Forest started a special experimental station on the western limits of the Fair Grounds near the Boer War Exhibit. The object of this was to increase distance of transmission. Obviously there were but two methods by which this could be done. We had either to increase the power of the transmitter or develop the sensitivity of the receiver. The former plan was adopted and a twenty-kilowatt station was planned—of exactly twice the power used in any previous experiment. It seemed as though when we doubled our power we increased our troubles at a compound ratio. As there were no stations operating at that time it was not necessary to concern ourselves about selectivity of tuning. The immense void of ether above us was free to use without the least fear of interference.

I was placed in charge of this station, where, in company with Dr. De Forest, we experimented for many weeks in privacy and free from the madding crowds around the other wireless exhibits.

The new experimental station was called the "Jerusalem station" because of its proximity to the Jerusalem Exhibit. It was the first high-powered station in the world. It was soon found that many of the principles employed in the ten-kilowatt station did not apply to the new station with its 60,000 volts of oscillating current. Heretofore we had been handling just a big lot of current, while now, comparatively, we were playing with miniature lightning of static electricity and did not know very well how to handle it.

CONDENSERS SEVEN FEET LONG

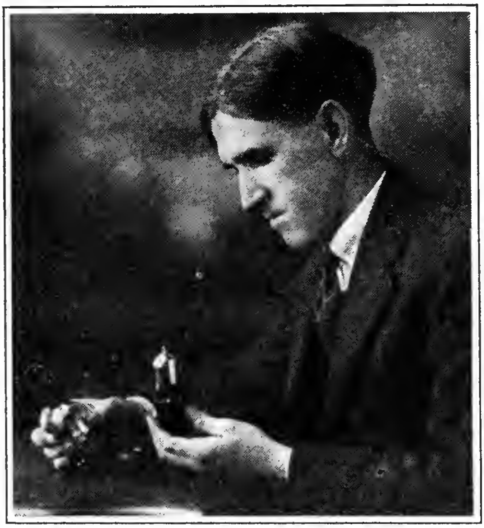
THE spark-gap condensers, instead of being Leyden jars, were made in heavy two-inch plank boxes, seven feet long, two and one half feet high and equally wide, and liquid-tight to hold kerosene. Immersed therein were two large sections of plate glass upon which heavy sheets of tinfoil were pasted on both sides. Each complete tray weighed about a ton, and from four to six of these tanks were used. Huge transformers six or seven feet high "stepped up" the tremendous voltage. The spark gaps had terminals one and one half inches in diameter upon which a cold blast of air from an electric blower was constantly blown. Telegraph keys, even of extra large design, were impossible to use, so we devised a long handle arrangement which operated like a pump. The contact points were encased in a tank of oil to prevent arcing and fusing. Imagine pumping water at the old town pump for half an hour,—that's how we sent signals before we discovered a better way. Our test signal was always the Morse letter "D" consisting of "dash, dot, dot." This would be sent out for hours at a time. We occasionally changed the helix adjustment or the condensers.

Our experiments continued to result in nothing but one failure after another. Some-

AT THE NEW YORK RADIO SHOW

Last October. Mr. Butler is talking into a microphone connected to a De Forest "singing arc," built in 1907. The "singing arc" was one of the earliest methods of producing continuous waves for wireless telephony and the three-element vacuum tube of DeForest successfully superseded it

times, after days and nights of hard, painstaking work building up the series of condensers we would "blow up" the entire set in an instant, smashing the heavy glass plates to small pieces, blowing kerosene all over us and over the premises, only to gather up the fragments, rebuild with new glass and tinfoil, change the experiment, and try another hook-up. Static electricity was so free and unharnessed in this station, that it was not at all uncommon to get a "poke" in the head or elbow if one came within a foot of the apparatus while it was sending. The roar from the spark gap could be heard a block away and it held its own in noise intensity with the ballyhoo bagpipe of the Jerusalem Exhibit on the one side and the cannonading in the Boer War Exhibit on the other. The odor of ozone, mixed with kerosene, was always present. And hour after hour, one of us was listening-in with the headphones with ears strained to the utmost. Nothing in that long period of experimenting was more tiresome than this.



1907–1924
Mr. Butler is holding a De Forest audion tube made in 1907 and contrasting it with a tube made by the same company in 1924. He hazards that the 1907 one is perhaps the oldest tube in existence. The old tube was made with a fragile double filament so that when one burned out, the remaining one could be used. Their life was very short. The grid and "wing" were on opposite sides of the tube. The "wing"—now called the plate—was a flat piece of metal and not a tube as is used to-day

DOING THINGS NEVER BEFORE DONE

THUS, blazing the radio trail, we encountered the immensity of space. We listened-in on this infinite space and heard nothing. The silence was at times unbearable; the waiting, nerve racking; but always there were hope and expectancy. It was a royal game of angling. We changed things, fussed and fussed and experimented, still hearing nothing except an occasional rift of static which at that time was a blessing, because it meant that we were at least "getting something." Oftentimes we were awed at the thing we were trying to do. There was something uncanny in trying to snatch the tangible out of the intangible nothingness of the free air. No wonder folks doubted our sanity. However, our longest waits were always rewarded, and finally, we accomplished what we had aimed to do. The thrill then was indescribable because the very thing we had just accomplished had never before been done by man. We never thought then that in our little way we were piecing together some of the foundation stones of the huge radio structure which exists to-day. In his memoirs of those days, Dr. De Forest writes:

"Night and day there is no respite from care, from toil, from interest. But it is a life well worth the living, the full accomplishment such, perchance, as is not given to many. Those who once enter this work, on whom the enticing spell of the wireless once falls, never quit it, no matter what the demands on patience, nor how great the sacrifices—always hopeful, always in effort, fascinating forever."

Control of the apparatus having been achieved, we immediately began to smash records for distance. The first event was on September 5th, when communication was established between St. Louis and Springfield, Ill., a distance of 105 miles. On this occasion, President Francis of the World's Fair sent the following wireless message to Governor Yates of Illinois:

I salute you as the distinguished executive of a great commonwealth by the modern means of communication, the wireless telegraph, a great achievement of science, of the marvelous advancement of which this universal exposition furnished many interesting evidences. I hope to see you within these grounds often during the remaining three months of the St. Louis World's Fair.

Shortly afterwards, communication was established with the Railway Exchange Building in Chicago, a distance of 300 miles.

In writing of this event of September 18th, 1904, Dr. De Forest says:

"This was indeed a stride in progress, fulfilling careful promises, crowning long and discouraging efforts. Especially significant was it that the formal opening of the St. Louis-Chicago service should occur on Electricity Day at the Fair with the Jury of Awards and the Delegates of the Electrical Congress present."

It is amusing to recall the elaborate precautions this austere body of officials took to make certain that this new service was actually by wireless. Some of the party was stationed at Chicago and the remainder at St. Louis. Complete communication was maintained all afternoon to their entire satisfaction, and as a result we were awarded the Grand Prize which was one of the highest honors bestowed upon any exhibitor.

Upon the strength of these singular accomplishments the United States Government became so interested that a contract was signed to erect five similar high-powered stations in the West Indies, each station guaranteed to work successfully one thousand miles. This was a distance *three times* greater than that we had just bridged, but with light heart and high hopes we packed up our tools and started south for new worlds to conquer.

Little did we dream of the tremendous difficulties awaiting us and the months of tedious, sweltering days ahead before our task was accomplished.

***The next article of this series will describe and illustrate the events of this tropical venture.*—THE EDITOR.**

WEATHER BUREAU

U. S. DEPARTMENT OF AGRICULTURE

Program for Broadcasting Weather Forecasts and Reports by Radio—Illinois Section

NAJ, Great Lakes: (151 Kc.) 9.45 A. M.—Morning lake forecasts; 4.00 P.M.—storm warnings; 10.00 P.M.—evening lake forecasts. (In code).

WLS, Chicago: (870 Kc.) 1.00 P.M. to 2.00 P.M., except Sundays (probably about 12 M. after Sept. 14)—morning state forecasts, general forecast, special forecasts, weather—crop summary on Wednesday, special warnings issued after sending hour, broadcast immediately.

KYW, Chicago: (560 Kc.) 12.00 noon, (11.00 A.M. during local "Daylight Saving")—morning local forecast, state forecasts, lake forecast; special warnings at 2.15 and 4.15 P.M.; 9.25 to 9.30 P.M.—evening local forecast, state forecasts, lake forecast, aviation forecasts. Monday, "silent night."

WAAF, Chicago: (1050 Kc.) 10.30 A.M.—morning local forecast, state forecasts, general forecast, general weather conditions, aviation forecasts, shippers' advices during winter season; weather-crop summaries on Wednesday during crop season; 12.30 P.M.—repeats the 10.30 A.M. information and on Saturday gives weekly outlook. Silent Sundays and important holidays.

WGN, Chicago: (810 Kc.) 10.00 A.M.—morning local forecast, state forecasts; 9.35 P.M. or later, at end of regular program—evening local forecast, state forecasts, lake forecasts, aviation forecasts, general forecast, general weather conditions. Monday, "silent night." Sundays and holidays irregular.

WOC, Davenport: (620 Kc.) 11.00 A.M.—morning local forecast, state forecasts, river forecast, general weather conditions, weather—crop summaries on Wednesday; 12.15 P.M.—forecasts repeated; special cold wave warnings sent as flashes. Tuesday, "silent night."

WJAN, Peoria: (1070 Kc.) 9.15 A.M.—morning local forecast, state forecast, shippers' forecasts, general weather conditions, special warnings; repeated at 10.30 A.M. and 12.30 P.M.

WEW, St. Louis: (1072 Kc.) 10.00 A.M.—morning local forecast, state forecasts, general weather conditions, river forecasts; special warnings at 5.00 P.M.

KSD, St. Louis: (550 Kc.) 10.40 A. M.—morning local forecast, state forecasts, general weather conditions, river forecasts and stages; special warnings at 12.40 P.M., 1.40 P.M., and 3.00 P.M., 10.00 P.M.—evening state forecasts.

Amateurs receiving weather forecasts are requested to advise (by mail) Weather Bureau Office, Springfield, Ill., of the quality of service received and how distinctly the stations are heard.

W. F. FELDWISH
Meteorologist in Charge.

The Rolls Royce of Radio

A Simplified Story of the Super-Heterodyne, Removing, for the Layman, the Mystery of Its Workings—Who Developed the Receiver and How It Works—Another Family Tree Diagram

By JULIAN KAY

THE fourth article by Mr. Kay in his "What's in a Name?" series should be of interest to the great majority of radio readers. His first article (June, 1924), sorted out and classified the radio receivers in present use. The next, in July, explained radio-frequency amplification. The third (November, 1924), discussed audio frequency amplification. Each article was accompanied by the novel Family Tree diagram. One hears so much these days of the super-heterodyne and what it will and will not do, and glib bandyings about of names common to the "super," that it is not unnatural to wonder if all the radio conversationalists really know their subject. Mr. Kay has here tried to bring together the facts about the "super" without growing too technical. The Family Tree diagram for the super-heterodyne will be found more than usually helpful.

—The Editor.

OF ALL the dynes and supers of modern radio, there is one receiver that seems to have preëminent claim to be both a "super" and a "dyne." That receiver is the Super-heterodyne.

The "superhet" as this receiver is familiarly called, is the result of much work by many men. The names most closely connected with it, Fessenden, Armstrong, and Houck, are only a few of those who have devoted time and energy toward making the receiver an electrical and a commercial possibility.

The invention of the "heterodyne" part of the name is due to Professor Fessenden of Pittsburgh, one of the earliest investigators in the realm of wireless telegraphy. The "super" part was attached by Edwin H. Armstrong after he had applied the heterodyne idea to vacuum-tube circuits.

To this creator of circuits is credited much of the development of this remarkable receiver as we know it to-day.

One of the most interesting demonstrations of the practical efficacy of the super-heterodyne was given by Paul Godley, a very well known Eastern amateur, in his famous Scotland experiment three years ago. Using a home-made receiver of this type, at Ardrossan, Scotland, he succeeded in receiving and identifying many American amateur signals at a time when neither transmitting nor receiving stations had advanced to their present efficiency.

Although the fundamental idea underlying the super-heterodyne is simple enough, the practical difficulties are many, and to build one of these "Rolls Royce" of radio is more a task for an experienced radio constructor than for the ordinary radio layman. From the Greek origin of the term, one may gather that this receiving system has something to do with a force that arises through a "change." A dyne in modern science is a unit of force equal to about one five hundred thousandth of a pound, and "heterodyne" suggests a change or variation. In fact this receiver is a "frequency-

Do You Know—

—What "beats" are?

—What heterodyning is?

—The principle on which the "super" works?

—Why the super-heterodyne is so sensitive?

—Why a super-heterodyne should not be used with an antenna?

—What the "local oscillator" is?

—The function of the "first detector" tube?

—The advantage of the second harmonic super-heterodyne?

changing" device, and therein lies its great selectivity and the remarkable amplification of signals it brings about.

WHAT THE SUPER-HETERODYNE IS

NOW, just what is the super-heterodyne principle?

The fundamental idea is based on a physical phenomenon known as beats, which occurs

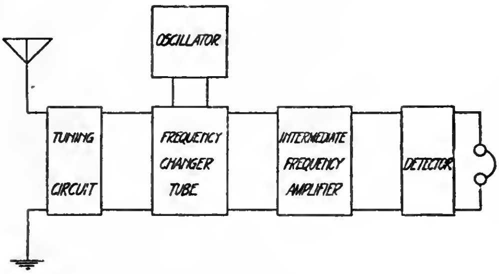


FIG. I

The super-heterodyne idea. The frequency changing or mixing tube, is often incorrectly referred to as the "first detector" tube

when two slightly differing vibrations are compounded. For instance, if two tuning forks are struck, one of them corresponding to middle C, or 256 vibrations per second, and the other, a few vibrations more per second, a sensitive ear will distinguish three tones. Two correspond to the vibrations of the two forks, and the third will be much lower in note, in fact it will be the difference between the other two.

In the article in this series on radio-frequency amplification, it was pointed out that it is much more difficult to build an amplifier for high frequencies than for low frequencies. This becomes a real problem when we realize that the middle of the broadcast range (about 300 meters) corresponds to frequencies of the order of a million cycles per second.

The trick of the super-heterodyne then, is to "beat" the incoming high-frequency signals with a local oscillator, and to amplify the resulting low-beat frequency.

Now, strangely enough, this beat frequency has all of the irregularities of the original radio frequency, that is, the voice and music will appear in the low beat as well as in the high transmitted note.

And therein lies the efficiency of this type of receiver—it amplifies comparative low frequencies where it is easily possible to build good amplifiers.

THE SUPER-HETERODYNE

THE "superhet" of Armstrong is really a complete receiving system, consisting of detector, "mixing tube," oscillator, and amplifiers, for both beat and audio frequencies.

Fig. 1 shows how the super-heterodyne performs its function of frequency changing. The input circuit, usually consisting of a receiving loop and a condenser, is tuned to the incoming signals. Then beats are produced by the local oscillator tube, then these beat frequencies are amplified by the "intermediate frequency" amplifiers to be finally detected and passed on to audio amplifiers and the usual output.

So much amplification is possible with this receiver that a small energy collector, such as a loop will suffice, thereby eliminating the unsightly and unhandy antenna. The receiver, however, may be loosely coupled to an external antenna.

The connection to the antenna may be made by running a single loop of wire about the cabinet, or by merely placing a turn of the antenna-ground system near it. In some cases the antenna may be attached to the loop, and on distant signals the external connection will be of aid, *provided* and only provided that the listener is out of the city away from the noises that Mr. Van Dyck in his series, "Man-Made Static," discussed in RADIO BROADCAST.

If used with an antenna, the super-heterodyne will radiate because of the local oscillator. It is entirely possible to use a

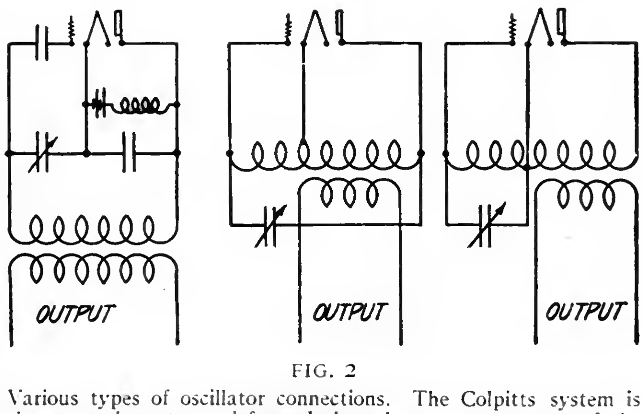
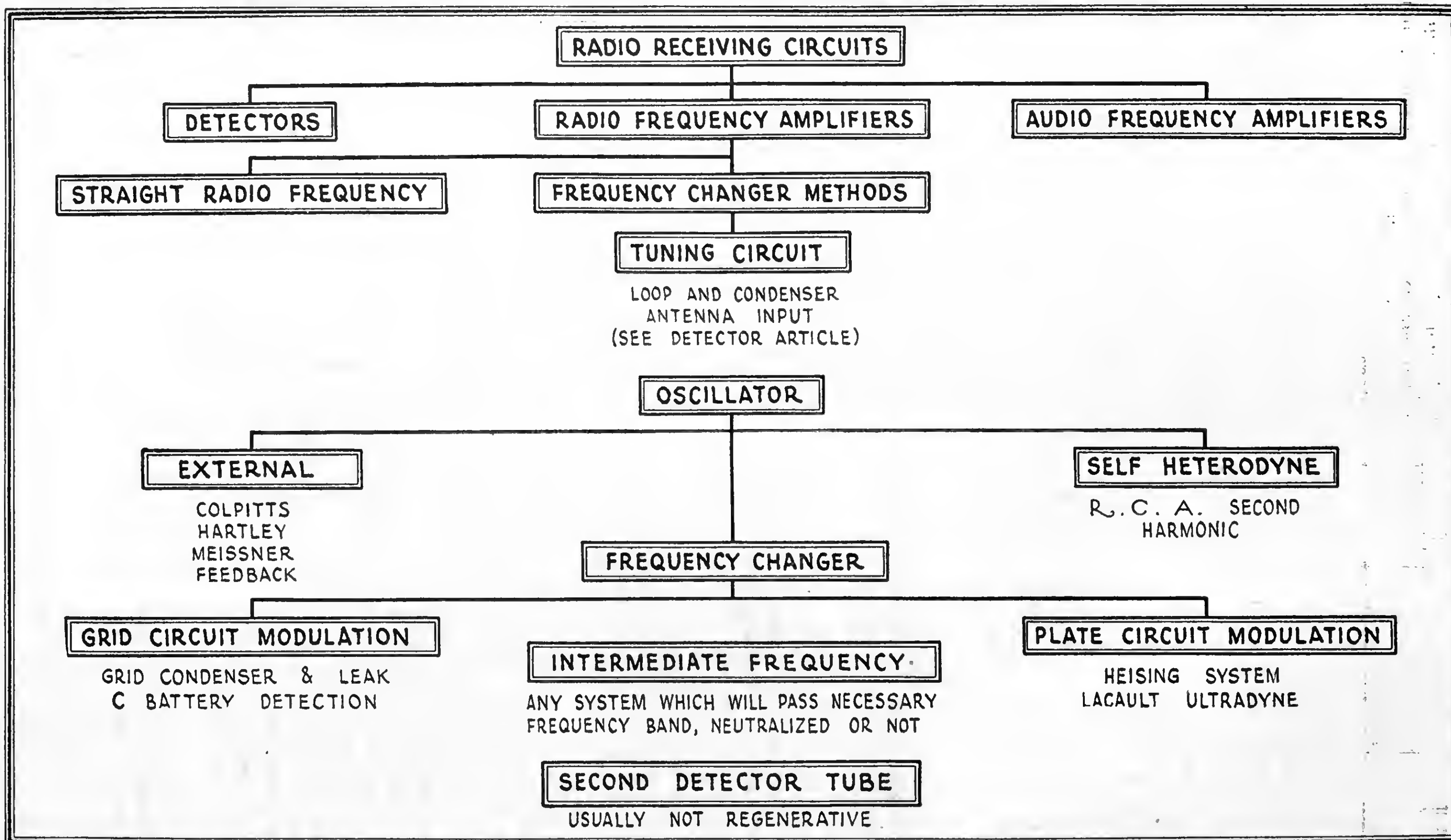


FIG. 2

Various types of oscillator connections. The Colpitts system is shown at the extreme left, and the others are two types of the Hartley circuit



SUPER-HETERODYNE FAMILY TREE

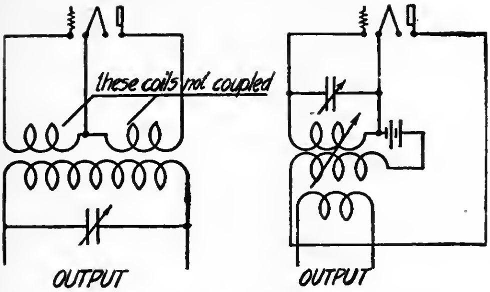


FIG. 3

Various other types of oscillators. The Meissner is at the left and a feedback system at the right

stage of radio-frequency amplification ahead of the first tube. Such a stage may be one of the several types described in the second article of this series. This radio-frequency amplifying tube will eliminate all possibility of radiation. The better plan, however, is to stick to the conventional method of using loop, detectors, and amplifiers.

The real superiority of the super-heterodyne actually fades almost to insignificance if its satisfactory operation requires an outside antenna because the development of modern receivers with a reasonably large antenna will practically duplicate in selectivity, volume, and distance the super-heterodyne's performance. A very striking example of such a receiver is the Roberts circuit when used with a good push-pull amplifier such as the four-tube arrangement known as RADIO BROADCAST'S four-tube Knock-Out.

WHAT THE SUPER-HETERODYNE WILL DO

A PROPERLY constructed super-heterodyne is one of the most sensitive receiving systems, that is now available, although not the most satisfactory from several points of view. The only limit to its range is the level of local noise, that is the interference from "bloopers," arc lamps, door bells, X-ray machines, street cars, elevators, etc. The "superhet" will receive anything that is in the ether, and anything that is above the level of the noise can be picked up and identified. But so will other receivers, lately developed.

The writer's idea of a radio Utopia is an island, say in the middle of Lake Superior, where the noise level is 'way, 'way down with a super-heterodyne to keep one company. It is to be understood that this is a *radio* Utopia!

On the other hand, if the owner lives in a congested area where the noise level is high, all the amplifiers in the world won't help him to hear signals from great distances, and a super-heterodyne will not work to full advantage.

THE LOCAL OSCILLATOR

FIGURES 2 and 3 show several common types of oscillators. The Hartley circuit is probably to be preferred. It is a simple, cheap, and good oscillator covering a wide range without change of coils.

The latest development in the super-heterodyne history is, as Major Armstrong has pointed out in RADIO BROADCAST, the "second harmonic" idea. Instead of using a separate oscillator, the first detector is made regenerative, and the frequency of oscillation such that its second harmonic will beat with the incoming waves. Use of the second harmonic makes the two tuning controls independent of each other, and eliminates one tube, which is an obvious advantage.

THE FREQUENCY-CHANGER TUBE

THE first detector, or the tube in which the actual shift in frequency takes place, may be one of two general types as the

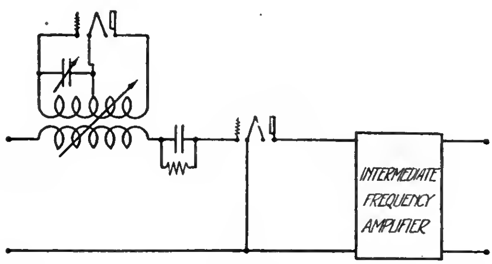


FIG. 4

The circuit of the frequency changer. The separate oscillator uses the Hartley connection. The output goes to the intermediate-frequency amplifier

Family Tree shows. The two frequencies may be mixed in the grid or the plate circuit. Of the two the former seems to be preferred.

Plate-circuit modulation may be used, as in the Ultradyne circuit. The Radio Corporation second harmonic super-heterodyne receiver, however, uses grid-circuit modulation. It may be pointed out here that broadcasting stations use plate-circuit modulation, and there seems to be no evident reason why this method may not be applied to the receiver. Fig. 5 shows a frequency changer of this type.

Another one of the tricks of the super-heterodyne lies in this frequency-changer tube. The output of this tube to the amplifiers that

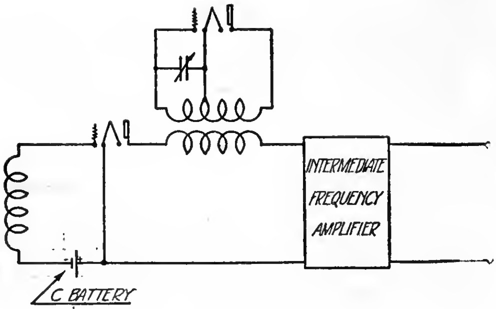


FIG. 5

Showing the frequency changing circuit with plate circuit modulation and C battery detection. In Fig. 4 a grid condenser is used for detection. The oscillator connection is the Hartley

follow, is dependent upon the product of two voltages, namely, the signal or incoming voltage and the oscillator voltage. For this reason it behooves the builder to make his oscillator as good as possible, for much of the efficiency of the entire receiver depends upon the proper functioning of this part.

Since the voltage of the second harmonic is less than that of the fundamental, it seems that the Radio Corporation super-heterodyne might lose some amplification by use of this feature, yet the advantages seem to outweigh the objections. The second harmonic idea was a brilliant one, and credit should be given Houck, its originator, who was one of Armstrong's associates in its development.

This business of multiplying two voltages to get the amplifier input voltage explains in a way why the receiver is so sensitive to weak signals. Suppose a station is tuned-in whose signals are weak, that is, they impress a small voltage on the loop. On an ordinary receiver this voltage is what actually operates the first tube. In the super-heterodyne this small voltage is multiplied by the relatively large one of the oscillator, and the voltage actually applied to the amplifiers is proportional to this product, not merely to the weak incoming signal.

Since the energy fed into the first detector is relatively high, in case of local reception, this detector usually functions with a C battery as shown in Fig. 5 instead of the usual grid condenser and leak. The reason is that the more conventional method may "block" if too strong a signal is applied to the tube. Any one can verify this by trying to receive when a near-by amateur is sending, or when heavy lightning occurs in the vicinity.

THE INTERMEDIATE AMPLIFIERS

CONFUSION seems to reign supreme on the matter of the intermediate-frequency amplifiers. Perhaps it is because they belong to the far-famed "superhet," perhaps it is because it is difficult to buy, or more difficult to build good ones.

Any of the amplifiers described in Haynes' article on page 408 of the September number of this magazine may be used in the super-heterodyne—*provided* that it passes the required band of frequencies.

Now let us see what this signifies.

The usual band of frequencies broadcast extends up to about 5,000 cycles. This means that an amplifier must pass at least twice that band in order that the speech or music be true, that is, without lopping of the high violin harmonics, or the "s's"

In the usual receiver operating at 300 meters,—or 1,000,000 cycles, the band required is $\frac{10,000}{1,000,000}$ or one per cent. of the radio frequency. That is, if the receiver is so sharply tuned that it can differentiate between one million and one million ten-thousand cycles, the reception will be poor. Such sharpness is not attained, and the music and voice frequencies are all received.

In our intermediate amplifiers, however, another story must be told. Here we have a beat radio frequency of 50,000 cycles, or 6,000 meters, and if the usual band of 10,000 cycles is to be faithfully transmitted by each amplifier, they must be comparatively broadly tuned. In this case the band is $\frac{10,000}{50,000}$ or twenty per cent. of the beat frequency.

In other words, the usual type of resonant circuit will not suffice, for it is too sharply tuned and part of the speech band will be chopped off. This will result in distortion. Transformers with flat characteristics are

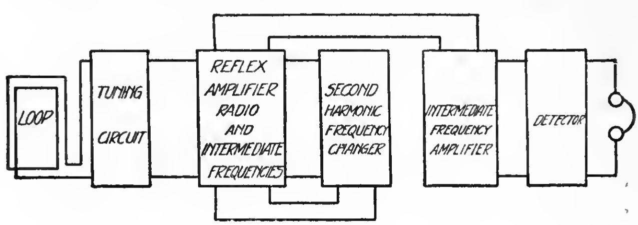


FIG. 6

The scheme of connections for the second harmonic super-heterodyne developed by Armstrong and Houck. Reflexing is employed in the first intermediate-frequency stage, which saves one tube

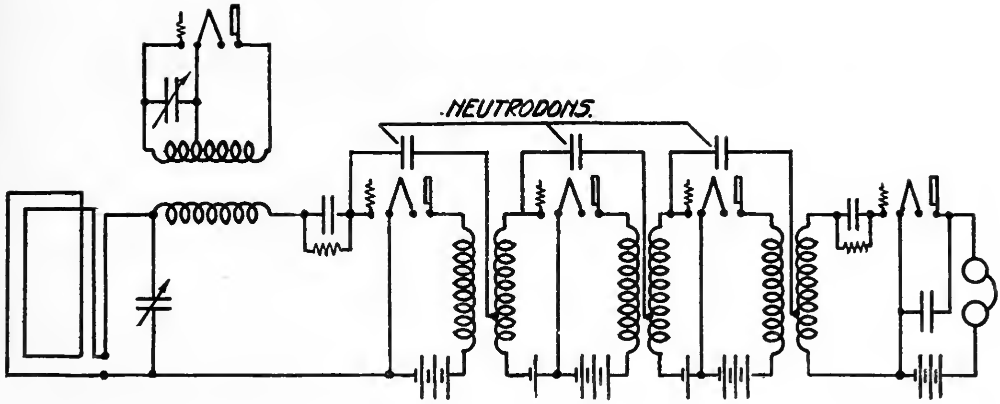


FIG. 7

Diagram of a two-control super-heterodyne showing the principles described in the accompanying article. There is a loop for receiving, tuned by a condenser, and the Hartley oscillator circuit is used. Grid condenser modulation is employed. The intermediate-frequency amplifier is coupled by untuned transformers, and the tubes are neutralized. Detection is accomplished in the last stage by the usual grid condenser method. No audio amplifiers are shown, but would be connected where the telephones are indicated

usually best for the interstage coupling. Such transformers should be paired so that they work together properly. This is a matter for the laboratory-equipped engineer.

THE SECOND DETECTOR

FOLLOWING two or more stages of intermediate or beat-frequency amplification, the signals are fed into a second detector from which they pass to the output circuit as usual. This detector tube operates by means of the usual grid condenser leak method. It may or may not be regenerative, but if so, it must oscillate at the beat frequency.

There is really no object in making this detector oscillate, provided that the remainder of the outfit is made properly. All the signal strength that one can stand will be attained before the second detector is reached, so there is little use in making the apparatus more complicated than necessary. If the intermediate amplifiers are giving enough gain that they have to be neutralized to keep them from howling, one may rest assured that he is getting all possible out of the equipment.

In one of the Radio Corporation models, one of the intermediate amplifiers is reflexed, thereby eliminating one vacuum tube and bringing the total number down to six.

If a loud speaker is to be run from this receiver—and it is not wise to try a pair of phones on a strong and healthy "superhet"—a stage or two of audio-frequency amplification may be added. If the intermediate amplifiers pass the required band, and if the last detector and the audio-frequency amplifiers are not overloaded, undistorted music and speech should arrive at any part of the country from all other parts of the country, during the winter and at night.

What more could any one ask of any receiver?

"THE VOICE OF THE CITY"

IS, IN New York, at least, a radio voice. James C. Young's excellent article, telling what station WNYC is doing in New York and the possibilities of municipal broadcasting will be one of the interesting features in the January RADIO BROADCAST.

How to Build a Knock-Out Amplifier

A Highly Efficient and Easily Built Amplifier Unit Combining Resistance and Transformer Coupling

By ZEH BOUCK

IT IS unfortunate that many radio writers lack experimental data, personally gathered, with which to bolster up their more general theoretical statements. Were such not the case, authors would have been less hasty and definite in the repeated denunciation of resistance-coupled amplification since RADIO BROADCAST introduced this system to the fan a half year ago.

There are few radio possibilities that have been more maligned than this truly meritorious system of radiophone amplification. Its economy of operation has suffered the most relentless criticism which a half hour of actual experiment and a half minute of unclouded thought would have demonstrated to be unjust and without sound foundation.

The sole objection that holds more than a negligible amount of water is the fact that transformer-coupling permits greater amplification per stage than the resistance-coupled system. The resistance-coupled amplifier permits a theoretical maximum intensification equal to the amplification constant of the tube. That is, the potential applied to a succeeding tube is equal to that applied to the preceding tube times the amplifying ability of the repeating bulb. This limit, however, can only be approached—never attained. A transformer-coupled stage permits a greater intensification that is roughly equal to the amplifying ability of a resistance-coupled amplifier multiplied by the turn ratio of the transformer.

The truth is that neither resistance coupling nor transformer coupling is in itself perfect, each arrangement being deficient in qualities possessed by the other. A consideration of the characteristics of each amplifier will be enlightening in that it will indicate a method of combining the two systems. The composite arrangement exhibits both the superior amplifying ability of the transformer-coupled amplifier and the perfect quality of the resistor intensifier.

Facts and Fancies

The resistance-coupled amplifier has come in for a lot of criticism from many in the radio industry who ought to know better. If the laboratory tests they claim to have made actually were made, there is something radically wrong with their laboratory methods. In this timely article, Mr. Bouck, who is widely known as one of the soundest of radio technicians, describes a unique and very satisfactory amplifier which happily combines the desirable features of resistance- and transformer-coupling. Two other applications of resistance-coupling to an amplifier have been described in this magazine by Mr. Bouck, one in June, 1924, where resistance-coupling was added to the one-tube knock-out reflex and in October, 1924, where a two-stage resistance-coupled amplifier was added to the Roberts circuit. This amplifier unit should not be used with any kind of a reflex receiver, because such an arrangement would bring two stages of transformer coupling into play.

To those who criticize resistance coupling, we wish to extend an invitation to visit our laboratory. If they wish to do so, they may bring any receiver of this type with them for comparative test.—THE EDITOR.

TRANSFORMER DISTORTION

THE only objection to the usual transformer-coupled amplifier is the distortion which is almost invariably evident when amplification is continued to loud-speaker intensity (that is, two or more steps). Assuming the proper operation of a cascade amplifier in respect to the biasing of grids, distortion is promoted in several ways. The first consideration is the ineradicable tendency of the transformer to favor certain frequencies—usually those of a medium high period. In a well designed

transformer, this characteristic is somewhat subdued, to the extent that distortion cannot be discerned even by the trained ear, *in a single stage of intensification.* However, if amplification is continued through additional stages, perhaps only one, repeating through the same general type of transformer, the following transformer will emphasize the distortions originated in the first step. The effect is thus cumulative, and the distortion is finally evident to the average ear.

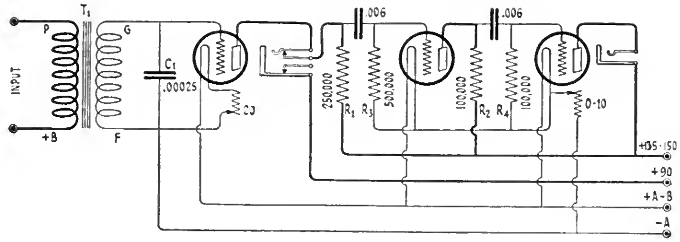


FIG. 1

The circuit of the combination amplifier. In the majority of cases C1 can be eliminated. The detector is coupled to the amplifier in the usual way

Another phenomenon which will result in distortion is the non-uniformity of the magnetic action of a transformer when heavily loaded. More technically, in such a case, the inductive effect is no longer proportional to variations in the magnetizing current as the saturation point in the core is approached. Some audio transformers evidence such an action at comparatively small loads. The ounce of prevention is a larger core, which in turn is argued against by its inconvenient size and more worthy theoretical considerations. Distortion from this cause is probably encountered only in cases of excessive amplification, with high plate voltage and little or no bias, in which instances it is merely contributory to the general strain. *It should never be experienced in the first amplifying stage.*

Distortion in the tube itself is a phenomenon of uneven emphasis similarly confined to the last stage of transformer-coupled amplification. For satisfactory amplification, variation in grid potentials is limited to voltages

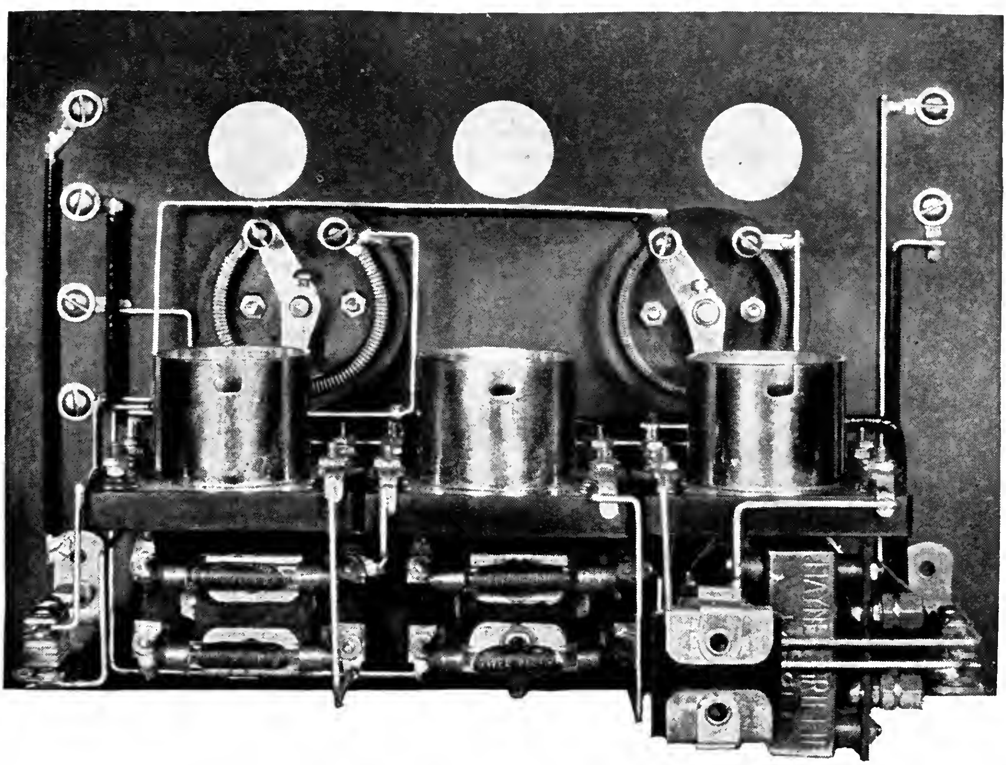


FIG. 2

A rear view of the amplifier. The selection of panel mounting parts makes a particularly compact and neat job

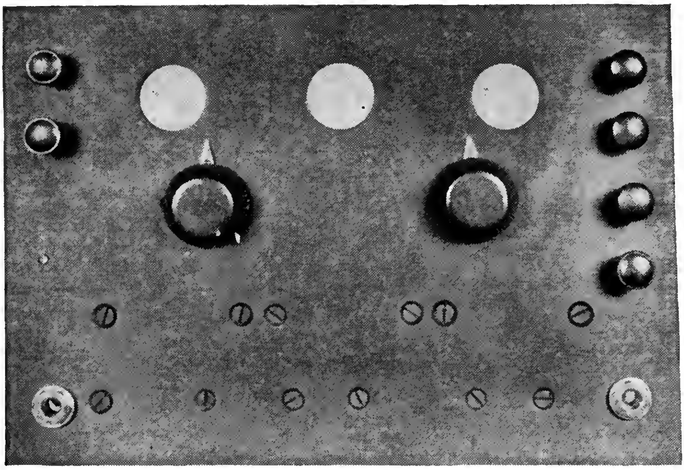


FIG. 3
The panel layout of the amplifier described. The design may be varied in order to maintain a consistent appearance of all receiving apparatus

projected by the straight portion of the usual "characteristic curve." However, in the transformer-coupled system, such variations are additionally confined to about half this workable portion, the negative or lower slope—which limits may be exceeded in the case of a strong signal in the last stage of amplification. Distortion will be the result. The impedance and resistance-coupled amplifiers are less restricted in this manner, for their operating characteristics permit a greater range of grid variations.

THE IDEAL AMPLIFIER AND ITS CIRCUIT

IT IS thus evident that the distortion in the transformer-coupled amplifier may be considered as being totally absent in the first stage. In this position, its superior amplifying ability recommends it as ideal. It is equally obvious that the case of the resistance-coupled amplifier has been similarly well established in the second and third stages where, free from the distorting characteristics of the transformer, it outputs an auditively perfect signal.

The reader will now grasp the possibilities of an amplifier consisting of one stage of transformer amplification followed by two stages of resistance coupling. The accompanying illustrations show such an amplifier, which thoroughly justifies the theoretical considerations outlined above.

Fig. 1 is the circuit of this ideal amplifying arrangement. The various values and connections have been determined experimentally and will give the best results on the average receiver. Transformer T1 is any reliable audio-frequency transformer with a turn ratio no higher than four to one. The .00025 mfd. condenser across the secondary is a Micadon, and connected in this manner it will improve the quality of some transformers. The capacity offers a comparatively low impedance to the high frequencies which may be over emphasized by the transformer—a discriminating "short" that irons out uneven amplification. Its desirability should be determined by experiment.

R1 is the first coupling resistor, having a value of 250,000 ohms. This is considerably in excess of the usual resistance of 100,000 ohms, which is employed in the case of the second resistor, R2. Experiments have determined the higher value as the most satisfactory in the plate circuit of the first tube in this particular amplifier.

C2 and C3 are the isolating condensers of .006 mfd. capacity.

The grid leaks, R3 and R4 have respective values of 500,000 ohms and 100,000 ohms.

The rheostat and jack connections are quite self-explanatory.

THE PARTS

THE following is a list of the exact parts used in the amplifier illustrated and described. Equally reliable makes may, of course, be substituted for the designated apparatus with similarly satisfactory results.

One 7" by 10" panel;
One six- or ten- ohm rheostat;
One twenty- or thirty- ohm rheostat;
Three standard sockets;
One Haynes-Griffin audio-frequency amplifying transformer;
Two Daven Resisto-Couplers with necessary grid leaks and coupling resistors;
Two .006 Micadon or New York Coil condensers;
One .00025 mfd. capacity Micadon or New York Coil condenser;
Two Pacent jacks (one open and one closed circuit);
Six binding-posts;
And the necessary tail-washers, busbar wire, etc.

CONSTRUCTION

THOUGH the illustrated mechanical design is suggested to the average builder, the amplifier admits of several minor electrical and mechanical variations, such as a second stage jack, automatic filament control, and constructional changes to adapt the apparatus to a tuner of rather different appearance. It will be observed from the photograph, Fig. 2, that all apparatus, including sockets, are of panel-mounting design, which makes possible an exceedingly neat and efficient construction. The baseboard, may of course be used, if the designated apparatus is inconvenient or unavailable. Fig. 3 shows the panel layout and Fig. 4 is a descriptive drawing of the amplifier described, and recommended.

OPERATION

THE operation of the transformer-resistance-coupled amplifier is identical with that of the more conventional types. The indicated battery connections are made, and the output of the tuner wired to the primary of the amplifying transformer, the plus B battery and plate connections following through to the respective apparatus in the detector circuit. When inputting from the detector of a regenerative receiver, a telephone bypass condenser, which may be a Micadon, .002 mfd., should be shunted across the primary of the transformer, or from the upper (P) side of the primary to the filament battery. In most receivers, this condenser will be found included in the original tuning circuit.

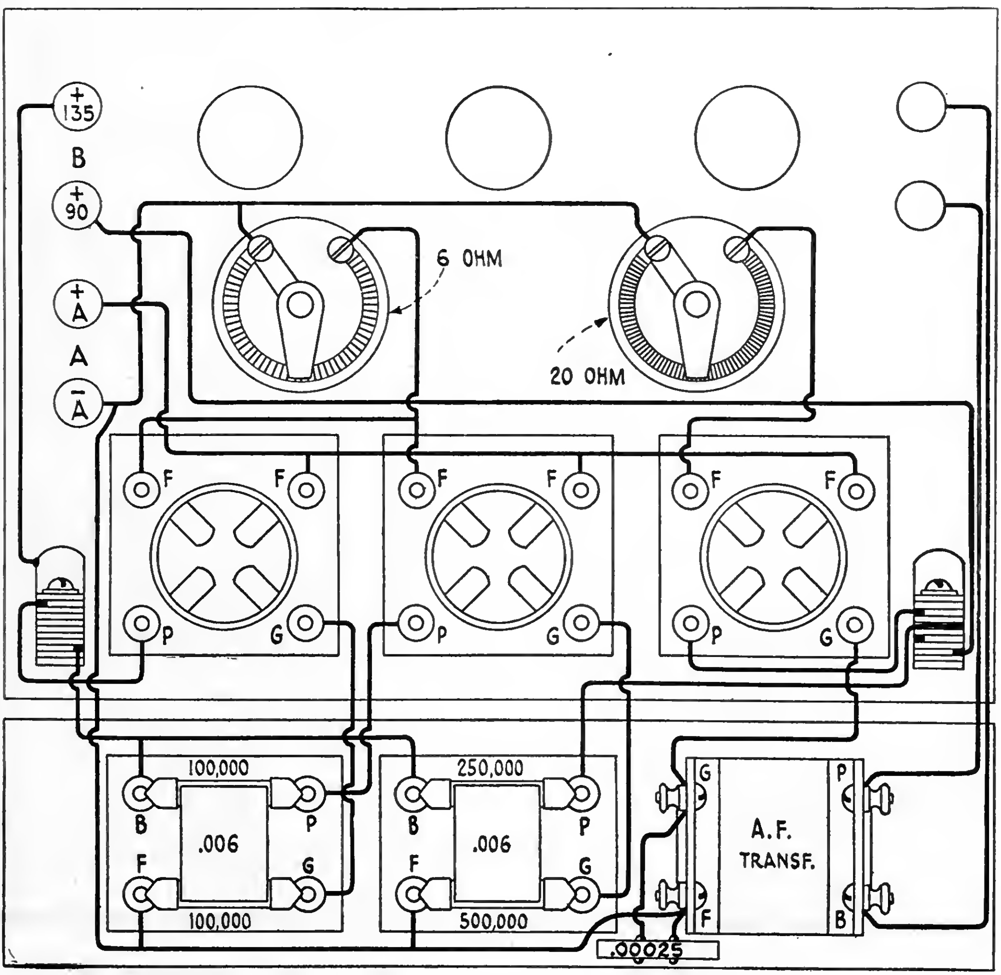


FIG. 4
A picture drawing of the layout and connections. This will be helpful to our less experienced readers, who, however, should train themselves to understand Fig. 1

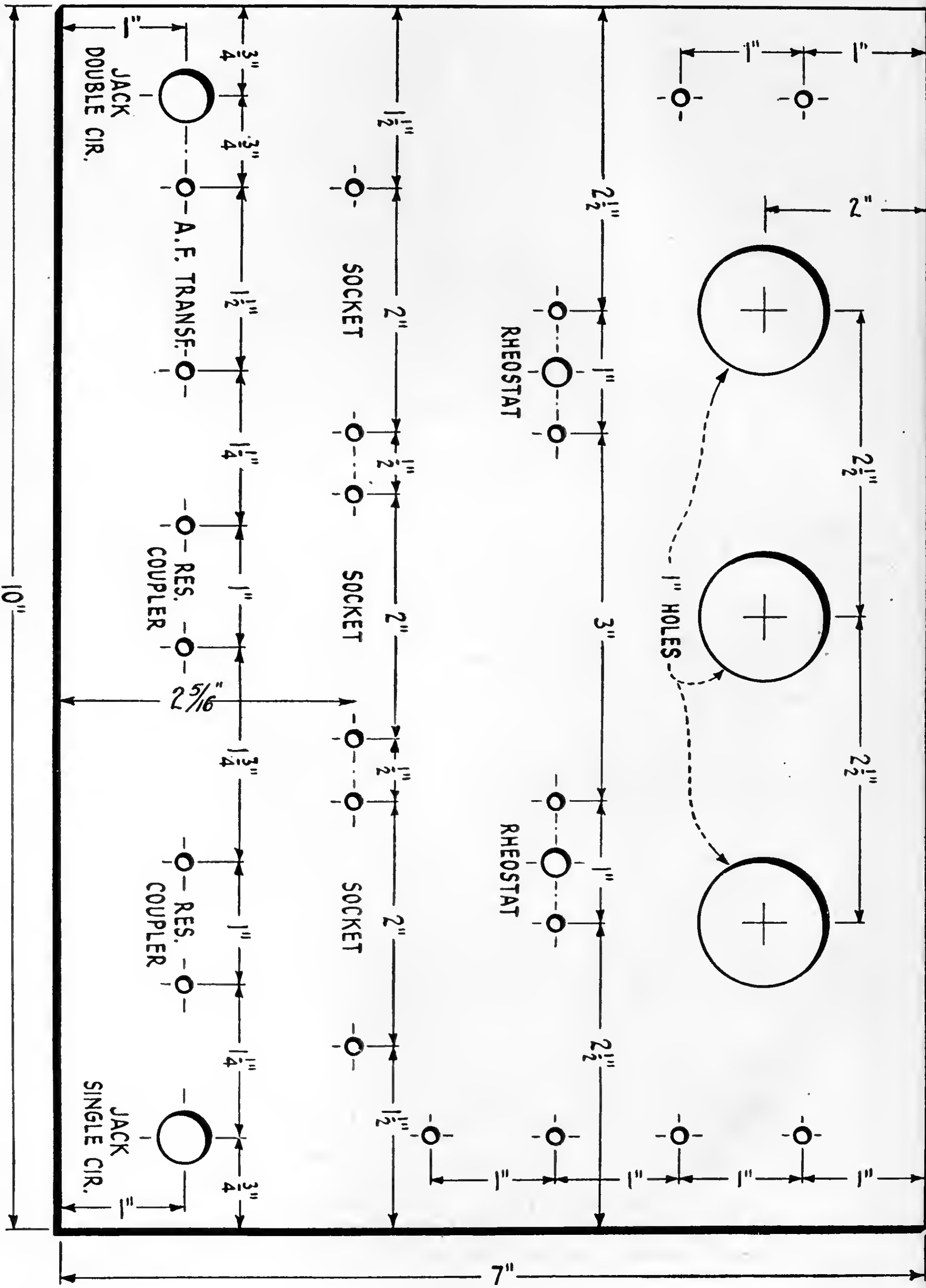


FIG. 5

Front view of the completed amplifier. Only two jacks have been used in the set described, in the first and third stages

Two plate voltage potentials have been indicated and extra posts provided, isolating the higher voltage from telephone receivers plugged into the first jack. However, if an amplifying plate voltage in the neighborhood of one hundred is applied, the two upper right hand binding posts may be shorted over, eliminating the necessity for an additional tap to the B battery.

TUBES

ANY of the standard tubes can be used in the amplifier described. One secures the best volume from the six-volt bulbs. The plate potentials should vary with the type of tube for best results. It is wise to keep close to the upper limit recommended by the manufacturer with the bias in the straight transformer-coupled amplifier. No bias however, should be used with the knock-out amplifier.

DISTORTION

CORRECTLY operated, the output of the amplifier described should be perfect as far as the ear is concerned. On exceptionally loud signals, and with some tubes, the final stage may "choke," which will result in harsh, grating reproduction. This strain can be remedied by lowering the resistance of the last grid leak, R4. Placing the fingers across the leak prongs on the resisto-coupler (lowering the resistance by shunting through the hand) is a simple test to determine if distortion is due to the overloading of the last tube. The UV-201-A is somewhat limited in respect to the power it will handle without distortion. For dance purposes in a large hall, a power tube, such as the Western Electric 216-A, with a separate rheostat, is recommended for the last stage.

Flatness, or loss of the high tones will generally be remedied by eliminating C1 (if used) or by bringing the grid leak of the last tube down to the plus side of the filament-lighting battery. This places a slight positive bias on the tube, operating the bulb a little higher on its characteristic curve. As the resistance-coupled amplifier "modulates down," in fact very emphatically on the higher audio frequencies, more room for a useful grid variation is provided by this connection. It is interesting to note that the writer has operated resistance- and impedance-coupled power amplifiers that were distortionless only when functioning with a *positive* bias, supplied by a C battery.

However, distortion *in* an amplifier built exactly as described will be rare. In the majority of cases, unsatisfactory quality can be traced to either poor tubes (generally bootleg) or the loud speaker, and should the simple remedies suggested in the preceding paragraphs prove of no value, the trouble may be external to the amplifier.

ECONOMY

THE plate-current consumption of the knock-out amplifier is unusually low, with the exception of the last stage, being under that of a well biased transformer-coupled intensifier. With one hundred volts plate potential, across both B battery posts, the first tube, when the amplifier is passing signals, draws about .17 milliampere (seventeen one hundredths of a thousandth of an ampere)! Under similar conditions, tube number two consumes one milliampere, and tube three, five milliamperes. It will be observed that the third tube consumes almost five times as much as the total plate current of the preceding amplifying tubes. This is due, of course, to the substitution of the loud speaker windings for the comparatively high ohmage coupling resistors. The plate current in the last stage can be materially reduced, without appreciably affecting volume, by including a five-thousand-ohm resistance in series with the loud speaker.

A MOTOR GENERATOR FOR BATTERY CHARGING

AN EXCELLENT article, by James Millen will appear in an early number of RADIO BROADCAST, which describes the theory and construction of a motor generator for charging radio storage batteries. The entire unit is not expensive to build and to assemble, and gives a very quick and economical method of charging the storage battery.

The Listeners' Point of View

Conducted By Jennie Irene Mix

Why Don't Great Musicians Aid Radio?

IF A majority of the leading musicians of this country would take a constructive interest in radio music, this particular feature of broadcasting would soon show marked improvement. At present they are a detriment rather than a help to the cause. They are quite willing to concede that there are unlimited possibilities for musical achievements of value through the radio, but they withhold activity in helping toward the development of these possibilities. Yet when radio music does finally attain a level sufficiently high to command the respect of the critical, these musicians, who are waiting for that day the while they are doing nothing to bring it about, will be among the first to seek the microphone for the promulgation of their work.

Perhaps this is only human. For in this commercial age, being a musician is at best a hard job. It may be asking a good deal to expect musicians to give much consideration to the radio as long as the radio does nothing for them in a financial way. But, now and then, one does come across one who is sufficiently interested in radio music to consider it in its relation to humanity rather than to his or her individual career.

ROBERT D. BONIEL

Director and announcer at station WEBH, Edgewater Beach Hotel, Chicago. It was from this station that the delightful surprise commented upon in these columns came not long ago

Such a musician is Mrs. H. H. A. Beach, the only American woman composer who has gained distinguished international recognition, and who, in addition to this, can hold her own among the men composers. An opinion on radio music from such a source is of far more than passing importance.

When asked to give this opinion, Mrs. Beach's reply, although brief, showed broad comprehension of the subject:

I should say that, in the main, its influence has been for good. I know that there are two sides to the question of its value to the composer, but so far as the public is concerned, I feel that much interest must have been aroused, especially in the smaller places, in the hearing of music. I have had personal knowledge of many people who live in remote districts, who have had wonderful happiness in listening to the artists and musical organizations which, otherwise, they would never have had an opportunity to hear. It is not only bringing enjoyment into lonely lives,

© Smith

JOSEPHINE LUCCHESE

—Coloratura soprano. What radio programs will be like when professional musicians are regularly featured, was demonstrated when Miss Lucchese, at present the leading coloratura of the San Carlo Opera Company, was heard from station WIP, Philadelphia. The career of this young American girl is being watched with much interest by connoisseurs of singing. WIP is to be congratulated on making it possible for a large radio audience to hear her.

but, in many instances, positive education as well.

But I acknowledge there is another side to the matter. I wish, of course, that the character of much of the music sent out through the air might be improved. In future this good may be brought about, not only by the improvement in the musical taste of the people, but also by the higher grade of artists performing.

This starts another and very vital question as to the remuneration of the artists. Where they give their time to music as a profession it seems highly unjust that they should not be paid for radio performances as for concert-giving. If such payment be not a regular procedure, then radio concerts will become merely a source of advertising to performers of immaturity or small reputation, who will take this method of making themselves known.

The radio, I believe, is merely at the beginning of its career, and what the future will show it seems impossible to predict. On the whole, I believe that it has already proved itself a blessing to many music lovers. If certain disadvantages have shown themselves, these may be remedied by concerted action on the part of radio stations, artists, managers, and the public itself.

This conclusion to a fair-minded estimate of radio in its relation to music, suggests what many of us believe to be the best method by which the present shortcomings in radio music can be done away with: "concerted action on the part of radio stations, artists, managers, and the public itself."

The only one among these influences that could work this reform, single-handed, is the public. But why wait for the public to take the initiative? Combined action would bring results much quicker.

Mrs. Beach has herself been heard over the radio, having broadcast a group of piano numbers some time ago from station WRC at Washington. Mention of this performance was made in the subsequent number of this magazine. To play for a radio audience was a gracious act on the part of this musician, whose symphonic works have been performed

—Belden, Newark

PERRY AND RUSSELL

If any monologuist of to-day tried to get away with that once popular hit, "You Can't Play Every Instrument in the Band," these clever chaps who are called, "The Two-Man Singing Orchestra" would have the laugh on him. They not only play all those instruments in the picture, but sing while they're doing it. If you happen to have a grouch when you tune-in on them they'll give you a quick hunch toward cheerfulness. They have been making life joyful for listeners-in at station WOR

by every orchestra of importance in this country, and by orchestras in Europe and in England; who has appeared as piano soloist with these same organizations; whose choral compositions have been sung by noted choruses under the direction of the ablest conductors; whose piano works and songs are featured on many concert programs; and who, for many years, has appeared on the concert stage as a professional pianist.

Some radio enthusiasts may think it a bit patronizing to say that it was "gracious" of Mrs. Beach to play for them. But let it be asked of such as these: How many musicians of fame equal to that of Mrs. Beach have you heard over the radio? Of course, you have heard certain celebrated artists when the public concerts in which they appeared happened to be broadcast. But that is quite a different matter from hearing these artists play from a radio studio to which they had gone for the express purpose of broadcasting. We have a notion that you can count the number of such artists on the fingers of one hand and not use all the fingers at that.

ROSE BROWN, LEADING LADY OF THE KGO PLAYERS

That lovely voice of hers prompted a rush request to station KGO for Miss Brown's picture, for we felt sure that anyone with such speaking tones would be good to look upon. A good guess, it proved as all will agree who see the above photograph

Radio Popularity on the Pacific Coast

WHEN E. M. B., of Gold Beach, Oregon, wrote the letter on Pacific coast broadcasting stations which was published in a recent number of this magazine, he probably had little idea of the protests he would arouse. Not that any one has disagreed with the fine things he has to say about KHJ, at Los Angeles, or with his comments regarding his enjoyment of KLK at Oakland, California, and CKCD at Vancouver. It is his estimate of KGO at Oakland that has raised the rumpus. He remarks, with finality:

> KGO is a wonderfully equipped and powerful station with splendid programs of a certain high class, but the people in general do not care for them. They are not interested in cantatas, radio dramas, or operatic singing. When listening-in with me, visitors often ask me to shift from KGO to KHJ, KFI, or KPO, and are better satisfied with what they receive.

Where E. M. B. makes his mistake is in confusing his friends with "people in general." It is, for that matter, a rather large order to utter an *ex cathedra* opinion as to what "people in general," think about anything unless by this term E. M. B. means that large mass of people who do not do much thinking on any subject.

Among those who have entered an objection to this verdict regarding the KGO programs is Mr. H. S. Gibson of Logan, Utah. After stating that, as a constant reader of Radio Broadcast and a loyal supporter of KGO he cannot let E. M. B.'s letter go without "considerable protest," he adds:

> In marked contrast to E. M. B., when we tell the neighbors that KGO has a play scheduled, we are forced to get extra chairs. Our children, and also the neighbors', recognize at once music by the Arion Trio or other performers that have been on KGO programs. These kiddies, all under thirteen, base their respective vocal or instrumental abilities largely as they have heard KGO performers. . . . My only regret is that KGO does not have a program every evening.

To which we wish to add personal testi-

mony to the effect that KGO is one of the very few radio stations putting on musical programs sufficiently well-balanced to hold our attention to the end. A good program is generally such throughout, and a popular program is complete in itself.

It is but another case of "many people, many minds." But it is always a bit dangerous to judge many people by a few minds.

Can Radio Artists Play Only Chopin and Liszt?

THERE is scarcely a broadcast station of any importance from which we have not heard times without number the second, sixth and twelfth Rhapsodies of Liszt, and his "Liebesträume." Why do we never hear any of his "Études"? Or the "Années de Pèlerinage"? Or some among his fifty transcriptions of Schubert's songs?

As for Chopin, he is played almost as frequently as Liszt, and represented within an even narrower scope. A few Nocturnes, with the hackneyed one in E flat major far in the lead; a Waltz or two; and those Impromptus of the kind within a conservatory pupil's ability . . . this is the radio Chopin, the petted darling of the Parisian *salon*. Yet he was one of the most superb among the Titans that have put pen to paper to express their thoughts in music.

—Apeda, New York

MRS. H. H. A. BEACH

American composer of international renown who sees great possibilities in radio music

Numbers of pianists have been heard over the radio who seem quite capable of playing some of this composer's Études . . . the "Revolutionary," for instance. Likewise, the "Fantasie Impromptu," and the "A flat Polonaise." The former has been played, to be sure, but all too seldom. Yet many people are hungering for just that sort of music—people who were raised in musical centers and now live far from points where they can hear great music. To them the radio could and should be of a value it does not now fulfill for them.

So, to the pianists who are expecting to broadcast during the coming months, we suggest that they try giving their listeners some of the works by Liszt and Chopin that have not already been presented by radio times without number. Also we would suggest that they give some composers other than Liszt, Chopin, and Rachmaninoff a chance to be heard now and then. For instance, we suggest Mozart, Beethoven, Schubert, Schumann, Brahms—to name but a few.

—T. Kajiwara, St. Louis

MISS V. A. L. JONES

Program director and announcer at station KSD, St. Louis, is praised far and wide for the quality of her work

Musical Parodies Should Be Announced As Such

IF ANY one recited over the radio a parody of a well-known poem it would be announced beforehand as a parody. Were the

changed version given without anything being said either by the announcer or by the one reciting the poem, those who listened would object to hearing the well-known verses given other than as the poet wrote them. Why, then, should such liberties be allowed in music?

The specific instance giving rise to this protest was the performance of a man heard from station WTAM, who was announced as "Our Wandering Musician." If memory serves rightly, he was from Punxsutawney, Pa. Well, he was a wandering musician, all right. He did not jazz the numbers he played, at least not those we heard, but he added to them at his own sweet will. Rubinstein's "Mélodie in F" lost all its simplicity and wandered to the upper keyboard far from the region where the composer placed it. Octaves and chords unknown to the original composition were added.

We hold that such performances should be announced as the performers' versions and not as the original compositions. Such versions are not unusual in concert programs, but when did one ever hear of their being played without the program bearing the explanation that they were adaptations?

How Dramatic Readers Are Rated at Station WWJ

IT WILL be recalled by those who read this department regularly, that in the number preceding this one, Mrs. R. J. Quien, dramatic reader of Camden, N. J., objected strongly to Mr. Corley W. Kirby, director of station WWJ, having said that he had never heard a woman reader over the microphone who was not "terrible." And she then and there issued a challenge to compete with any man reader at some leading broadcasting station, that the public might decide between them. She also said that as proof of her success, she would like to have Mr. Kirby see the letters of appreciation she receives after each broadcast performance.

To which comes the following reply from Mr. Kirby:

> I am sure that Mrs. Quien has received many letters from those who have heard her give dramatic readings. You can do anything over the radio and get letters of commendation, because the radio audience represents a better cross section of the American nation than can be obtained in any other way.
>
> The problem of the radio station is to please the

—Strentz, New York

HARVEY MARBURGER AND HIS KEITH VAUDEVILLE ENTERTAINERS

If you have seen the Cafe L'Aiglon in Philadelphia, you'll know that the exotic setting arranged for this orchestra is quite in keeping with the place where they play. And they can make even jazz sound better than it really is, a statement you can prove for yourself by tuning-in WIP

—Krumhar, Cleveland

MAURICE SPITALNY

Director of the Hotel Statler Concert Orchestra at Cleveland, Ohio, heard during the dinner hour through station WTAM. The excellent work of this orchestra under Mr. Spitalny's leadership has been frequently commented upon in this department

greater part of its audience with each concert, and I am sure dramatic readers are not able to measure up to this standard. Whether they are men or women makes no difference. In strengthening my position I ask this question: how many dramatic readers have you heard from any stage? Certainly, if they were a real attraction, the theater managers would have realized it long before this.

As far as the contest proposition is concerned, I would put it in the same class with other contests. In the end they mean little or nothing. If we had a contest calling for an expression on jazz and classical music, jazz would win out, because the people who prefer jazz to all else are just the type who would enter into a contest with gusto, while those who prefer classical music would say little or nothing about it. These people take no interest in contests, but when they like a thing they will write a good constructive letter, where others would fill out a form postal card. Radio contests reflect the opinions of the radio audience to a smaller degree than the straw vote reflects the political tendencies of the country.

I am willing to be convinced as to the value of dramatic readers as entertainers and the value of radio contests. I feel sure that the latter will not be held from the Detroit *News*, station WWJ.

Can't Telegrams Be Original?

HERE is a suggestion for some station that would like to start a competition in which the winner will receive a prize.

Why not give a prize to the first person who, in telegraphing congratulations on a program, says something other than:

"Program coming in fine. Keep it up."

"Program great. Keep it up."

"Everything coming in grand. Keep it up."

"Fine program. Coming in great. Keep it up."

Station WTAS, at Elgin, Ill., recently offered a prize of a $250 Shetland pony to the one who gave them the best suggestion for a new slogan, WTAS having up to that time meant "Willie, Tommy, Annie, Sammy." We missed hearing who won the prize. It was an easy way to earn a pony. For who is there who could not improve on, "Willie, Tommy, Annie, Sammy"?

It would be much more difficult, apparently, to earn a prize through sending telegram containing some original sentiment commenting on the program then being heard. For the present form seems to be firmly fixed in the minds of all and sundry who like to hear their names put on the air as "among those present."

Good Band Music Is Coming from Prisoners through WOS

COMPILERS of musical statistics will tell you that few musicians are found in our prisons in comparison with the number of criminals drawn from other occupations. Yet there is that band heard at stated intervals from station WOS, and whose members are all from the Missouri State Penitentiary. Their numbers never seem to grow smaller, although from time to time the personnel of the band must change owing to this or that member having finished his prison term. The band plays so well that it speaks badly for the morale of the musical profession. It was hoped, until that band was heard many times, that the statisticians were right. But now their authority seems doubtful. There is a psychological aspect of this band's performances about which one might write an entire article. For men who can play with such engaging spirit must have much of good in their natures. To be sure, the public performer who simulates an emotion

for the interpretation of the work he is giving, need not necessarily have experienced that emotion. But he must have the imagination to conceive of himself as having experienced it. In the case of a worthy emotion, the nature is not lost that has sufficient imagination to portray it with the right feeling.

The Dangerous Microphone

SINGERS who present the best songs to the radio audiences are almost without exception the singers who, of all the vocalists heard over the microphone, have the worst diction. They would do well to listen to those who present only popular songs of the day and learn from them something regarding correct enunciation. It is seldom that one word is indistinct when these latter singers are broadcasting, while with the former it is seldom that one word can be understood. In their case the only way one can tell what song is being given is by the melody.

Good songs will be more popular with all classes of radio listeners when those singing them make themselves intelligible. If these singers at present are unappreciated the fault is largely their own.

The microphone never fails to make known to the radio audience when a singer is off the key. Of late, some have been heard who never got the pitch once during an entire song, and were seemingly quite unconscious of this fact, or indifferent to it in the belief that it would not be discovered.

Radio can make a singer's reputation or it can ruin it. The singers of popular songs seem to realize this far more than do those others who are expected to be taken more seriously.

Score One for Women Announcers

THERE is more to be added to the discussion that has been going on in these columns regarding women announcers. Miss V. A. L. Jones, of station KSD, St. Louis, judging from the letters received commending her announcing, is not only in the lead among the women filling this position at broadcasting stations, but ahead of most of the men as well. And ahead of *all* the men, according to Mr. J. C. Porter of Amargura, 23, Havana, Cuba. It is a pleasure to print the following excerpts from his letter.

> The object of this letter is to pay a well-deserved compliment to KSD's announcer, Miss Jones. There is much telegraphic interference here as well as the steady grinding static that prevails most of the year, and it requires an exceptional voice to cut through this mess and be intelligible. This, Miss Jones does. I can say as the result of more than a year's experience that there is not a voice coming from the States that we receive better than hers.
>
> In this day, when RADIO BROADCAST is running a series of articles under the heading "Is Woman Desirable—Over Radio?" I feel that such a very fine radio voice as that of Miss Jones deserves a word of appreciation. . . . We are a family of "radio nuts" . . . have six sets, and get the latest thing on the market. There is at least one set going every night, the year round, and this letter in praise of Miss Jones is the combined opinion of our family, based on full three years of dial twisting. . . . Here's hoping that for

CORLEY W. KIRBY

Of station WWJ, Detroit *News*, who started something when he came out in this department against radio dramatic readers. Nor has he backed down an inch, as you will discover when you read what he has to say in this issue

many seasons to come we may enjoy the clear, measured, and cultured voice of the best announcer that we hear from the States.

A charming and intelligent tribute. May it influence some of the patronizing announcers to mend their ways. In particular that one in Chicago who, although he has some excellent points, spoils everything he does when, after saying they are signing off but will be on the air again in an hour, calls out with aggravating cheerfulness: "See you later!"

Pleasure Unique and Unexpected

ONCE in a while something so delightful in its character and in its unexpectedness happens over the radio that one forgets all the recent disappointments after one tunes-in. The most delightful of such experiences came when, upon tuning-in WEBH at Chicago, this was heard:

"We are now about to make a very important announcement although it may result in your missing part of our program. We want all of you who hear this to go to your north windows and look out. You will see the most beautiful aurora borealis that has been seen for many years."

And it was even so. There, in the northern sky, was one of nature's most wonderful miracles. And many, thousands upon thousands, no doubt, would have known nothing about it if it had not been for the announcer at WEBH. Some of us are still thanking him.

An Elephant Dancing Among Daisies

THE old saying about taking a sledgehammer to drive in a tack was recalled when hearing a short time ago Mendelssohn's fragile, light-footed "Spring Song" played from station KFMX, at Northfield, Minn., on a trombone. Why any trombone player should choose such a number is beyond comprehension. An elephant trying to dance among daisies without touching one . . . that was how it sounded.

But there is no doubt that this particular trombone player could give his listeners much pleasure if he stuck to music that belongs to his instrument. The fact that he managed to cavort through the "Spring Song" proves this.

DURING a visit of the Memphis baseball team to Fort Worth the Rotary Boys' Band of Memphis gave a program from WBAP, the station operated by the Fort Worth *Star-Telegram*. They played better than half of the bands made up of adults, and here's congratulations on their work! Whoever is their director should also be congratulated. It was a real joy to hear such legitimate, sincere playing. And special mention should be made of the tone quality of the various instruments. For that, too, was unusually good.

IF, WHEN tuning-in a station it happens to be the moment when the announcer is speaking, one can tell almost instantly what station it is, provided it has been tuned-in before. For each announcer has a distinct individuality. But it is next to impossible to tell the station if music is going on when it is tuned-in, for the reason that most of the stations play the same things, night after night, week after week, month after month. But this state of things is going to change for the better. Put this down as a prophecy, if you wish. It is a safe prophecy.

THE frequency with which Edward German's "Three Dances from Henry VIII" are broadcast is sufficient testimony of their popularity with radio audiences. These charming pieces are especially well suited for performance by small orchestras, such as are maintained by radio stations; and the art with which they are often played by many of these orchestras speaks well for the performers.

It may interest listeners-in to know that Edward German who was born in England in 1862—was not named German at all, but Smith. It was Sir Alexander Mackensie, the British composer, who told the then young Smith that he could become famous by any other name, but never with the one he bore. As he was of German descent on the maternal side, Smith took the name by which he is now known. While he composed many works, he is now noted chiefly for his incidental music to Shakespeare's plays.

THE Piggly Wiggly Girls who are heard occasionally through KHJ, Los Angeles, can put up a pretty good program when they are so minded. There is an excellent violinist among them; they have some good pianists; and a number of the singers have more than average voices, well trained.

THE men whose broadcasting is confined to humorous monologues, or the telling of a succession of jokes, must have about the most difficult job of any among those who are regularly heard over the microphone. That most of them succeed in landing the point of the humor, shows them to be experts.

Can "Static" Interference be Eliminated?

Fertile Fields for Radio Experiment to Make Receiving Free From Natural Interference—Is Radio Development Tending the Right Way?—Some Concrete Suggestions of Great Interest

BY *WALTER VAN B. ROBERTS*

THE season has just passed when our radio sets frequently produce horrible cracks and frying and tearing and grinding sounds, to the more or less complete destruction of any pleasure in listening to broadcasting. One can scarcely listen to these barrages of noise without trying to figure out some way to eliminate them. It is proposed to consider here just what methods for reducing this type of interference are feasible at present, and also to make a few guesses as to possible future developments.

The most obvious attack upon the problem is the increase of power used by the transmitting stations. If we imagine that on a certain day all broadcasting stations were to increase their power tenfold, what would be the result? Evidently the owners of receiving sets could reduce the size of their antennae very considerably and still get the same loudness of signals as formerly. On the other hand the static noises would be much weaker on account of the smaller antenna. Interference between one station and another would remain the same because the *relative* strengths of the signals would not be changed by increasing the power of all of them proportionally. This increase of power is a very attractive method for reducing static interference and is being made and will very likely continue to be made.

When an Expert Speaks

Walter Van B. Roberts is one of the ablest writers on radio today, as many of the readers of this magazine have often written us. He recently joined the technical research staff of the Radio Corporation of America at their special laboratory at the College of the City of New York. In this article, which is easily one of the most interesting that has appeared in any radio publication for a long time, the author discusses what is truly one of the most serious problems in radio. "Static" is one natural force that the best of radio engineers have had great difficulty in mastering, and the end is not yet. The elimination of static is a problem in which everyone is interested and Mr. Roberts's presentation of the problem and six definite suggestions for development is extremely clear in its technical phase and decidedly thought-provoking.—THE EDITOR.

Meantime there is an independent precaution that can be taken at the receiving end to reduce interference. That is, to use a receiver that has the best possible selectivity. There is a very definite limit to the selectivity allowable in a receiving set used for voice or music, for in order to receive these it is necessary to receive equally well not merely a single wavelength or frequency, while listening to a given station, but a "channel" of frequencies about 10,000 cycles (or 10 kilocycles) wide. For example suppose we wish to listen to station WOO whose frequency is given in the newspapers as 590 kilocycles. A receiving set that is so selective as to receive only this frequency would not be able to pick up voice or music from WOO. The set should be made so as to receive equally well, and all at once, all frequencies from about 585 to 595 kilocycles while listening to WOO. Furthermore if the selectivity of the set is to be the best possible, all frequencies below 585 and all above 595 should, at the same time, be completely rejected.

THE IDEAL RECEIVER

IN OTHER words the ideal receiver should be like a slit or a door that opens only wide enough to let in the desired music. (In order to carry out this simile, we may say that good quality music is about 10 kilocycles

wide, while 4 kilocycles is as wide a range as speech needs to be satisfactorily natural and understandable). If the door is not opened wide enough the "side bands" will be "pinched" and the quality of the received voice or music will suffer. On the other hand, if the door is opened wider than necessary there is just so much more room for the static to get in. The super-heterodyne is the type of receiver best adapted to yield the ideal selectivity defined above, especially at short wavelengths. In fact, practically speaking, it can be said that probably no other type of receiver can be made to come anywhere near this ideal for waves shorter than three or four hundred meters.

In connection with the advantage of the best possible selectivity, it is interesting to note a step taken by the American Telephone and Telegraph Company in their recent experimental transatlantic radio telephone work. By using what is called "single side band" transmission, the width of channel required is cut in half, so that if the selectivity of the receiver is correspondingly increased, only one half as much static can get in as is the case with the ordinary type of transmission. This advantage is not the only one offered by single side band transmission, but the difficulties attendant in producing the single side band, especially at short wavelengths, and the difficulty of receiving music by this method, prevent its general use for broadcasting at present.

GREATER POWER AT THE SENDING END?

THE increase of power of the transmitter and the increase of selectivity of the receiver are unquestionably feasible methods for reducing static interference. There are however many ingenious inventors who will not agree with the following rather sweeping statement: Suppose that a typical broadcasting station is working on a wavelength in the ordinary range. Now suppose that some one using any conventional type of antenna experiences static interference while listening to the broadcasting station. The statement is, that no "filters," "traps," double modulation schemes, or any other arrangements, no matter how complicated, can ever do any more toward reducing the interference than can be done by simply making the selectivity of the receiving set approach the ideal character previously described. This is merely another way of expressing the view that static can be considered to be a mixture of disturbances of identically the same nature as the signals, and hence that the portion of these disturbances that acts like signals lying in a given frequency range will inevitably be received by any set that is receiving signals in this frequency range.

WHY NOT CHANGE THE ANTENNA?

THE above statement might seem to indicate that there can be no cure for the trouble. However, there are several conditions mentioned in the statement that suggest new methods of attack. For instance, why must we receive with a conventional type of antenna? Why not devise a very "directional" antenna, that is, one that has to be accurately pointed in the direction from which the waves are coming? Such an antenna would pick up only the small fraction of static disturbances that acts like signals coming from the same direction as the signals we want to hear. The loop antenna has this directional property to a rudimentary degree and hence gives a slightly better signal-to-static ratio than the usual open antenna. It is hoped that the use of very short waves will make possible antennae having very high "directional selectivity."

Again, why do we have to stick to the ordinary range of wavelengths? It is natural to expect the static interference to be worse in some wavelength ranges than others, and it may well be possible to work down to a wavelength where the interference is negligible.

A NEW TYPE OF WAVE, PERHAPS

SO FAR we have met the enemy face to face and combatted him in a straightforward fashion. It is not impossible however that we might have been able to avoid doing battle at all. For, upon finding that natural causes were already ahead of us in producing a certain type of electromagnetic disturbance, we might have said to ourselves: "Very well then, we will invent for our purpose some other kind of disturbance, one that Nature is not already producing, and thus insure that we receive nothing except what we transmit." As an example of possible experiments along this line, we might try using horizontally polarized waves; that is, waves turned over on their sides, so to speak. Such waves are emitted from a loop with its plane parallel to the earth's surface. Another possibility would be circularly polarized waves. These are a little difficult to describe and it will be enough to say that they are to an ordinary wave what a corkscrew is to a wavy line, or a

curl to a simple "wave" in the hair. In any case the receiving set would have to be designed *not* to receive the ordinary type of wave at all. While the signal-to-static ratio might very likely be improved by the use of these particular types of waves, it is extremely unlikely that complete freedom from static would be attained.

UNDERGROUND TRANSMISSION

UNDER the general head of "avoiding battle" comes the idea of transmitting from one antenna entirely buried under the earth to another similarly buried. Transmission free from static has been reported by some experimenters using this method. The writer does not feel prepared to criticize the possibilities of this method, and only ventures to wonder whether the phenomenon of "total reflection" could play any part in it.

Summing up the whole subject, we do not see much hope of eliminating static absolutely, but believe it to be readily possible to reduce the interference to any desired degree by the use of the methods (no two of which are mutually exclusive) tabulated below in order of practicability and importance:

1. Increase power of all transmitting stations.

2. Increase frequency selectivity of receivers to the limit imposed by quality considerations.

3. Work in region of wavelengths that experiment shall have shown to be freest from interference.

4. Increase directional selectivity of receiving antennae.

5. Decrease necessary channel width by use of single side band transmission.

6. Use some type of electro-magnetic wave that is less used by Nature than the type now used for broadcasting.

LIEUTENANT LOWELL SMITH

Acting Commander of the United States Army World fliers, who recently completed their 'round the world flight. Lieutenant Smith is describing his experiences before the microphone at station WCCO, St. Paul-Minneapolis. WCCO was formerly known as WLAG. At several cities, notably at Boston and New York, when the fliers arrived, greetings and speeches were broadcast to them in the air, and the answers picked up by the microphones of a broadcasting station on the ground and rebroadcast to radio listeners

INDIRECT ADVERTISING

By radio is regularly achieved by this orchestra which plays popular and semi-classical numbers from station WEAF, New York. It is the B. Fischer and Company Astor Coffee Orchestra. This company, one of a considerable number now doing indirect advertising "on the air" pays a fee of a certain sum per minute for the use of the broadcasting station as well as the salaries of the orchestra. Radio advertising is a new field about which very little is known

How Will You Have Your Advertising?

The Radio Advertising Problem is Similar to the Newspaper's—Should Advertising Be Permitted on the Air?—How Does the Public Like Ether Publicity

By JAMES C. YOUNG

WHEN Mr. Householder hurries home in the evening from a day's work and sits down beside his receiving set, his face does not always reflect that peace and pleasure that passeth all understanding, usually associated with radio. He is likely to get in touch with a station which has just announced that, "Mr. Albert Wagh of the Baked Bean Corporation of America will now describe the scientific preparation of the bean, from pod to pot."

This is publicity. Radio users throughout the nation, a large percentage of American advertisers, and all who come in contact with the public mind, are wondering just how far publicity can be carried in the field of radio. On that question will depend the future development of broadcasting, perhaps in a broader measure than any other one consideration. It is undeniable, of course, that no particular reasons exist why broadcasting stations should furnish a daily program of entertainment to the American public without any kind of compensation. Naturally these stations derive a reflective prestige which frequently is sufficient to warrant their maintenance, as in the case of department stores and similar establishments. But the fact remains undisputed that the man with a $5 receiving set is the one who enjoys the greatest benefit.

How can the broadcaster be paid? So far but one dependable method of return has been evolved, and that method is publicity. There are many shades of opinion as to what the public thinks about this intimate association of advertising and radio entertainment. A majority of the men who have studied the matter from the broadcaster's point of view assume to believe that the American radio audience, represented by three to five million receiving sets, does not particularly care whether the programs it enjoys are made available by direct or indirect advertising. But the statements of radio followers themselves show that there is a considerable and growing prejudice against the type of program in which the genesis and descent of that baked bean are discussed too extensively.

One large station that has broadcast publicity with marked success recently took a poll on the problem of publicity among 25,000 persons owning radio sets. The directors of this station concluded that the quality of entertainment was the determining factor in bidding for the radio public's favor, rather than the question of publicity. Just how far that conclusion can be trusted is a matter not easy to decide.

Advt.

Of late, there has been considerable discussion among radio listeners about advertising on the air. We have heard much that is pro and much con. There is a great group of the radio audience who contend that if radio programs are good in both content and execution, it doesn't make any difference to them if they are an advertising feature for some firm or other. Others feel, among them, the powerful American Radio Association representing many listeners, that the air should be free of all advertising. For many years all periodicals have been required to indicate that material appearing in news columns which is advertising must be so labelled. "Advt." has so become a very familiar abbreviation to newspaper readers. We think the question should be thoroughly discussed, and the opinions of listeners clarified and expressed, for that will make it easier for all. Radio Broadcast will publish some of the best letters received from readers on this subject.—The Editor.

IS PUBLICITY ALL RIGHT IF VERY GOOD?

With a numerous group of broadcasters accepting pay for the privileges of their stations it is not difficult for them to become convinced that the public has no strong objections to this practice. It even seems reasonably true that an excellent quality of entertainment will go far to neutralize opposition from listeners. If these matters are granted, we still may doubt that the great average of American radio followers will be content with programs in which the flavor of advertising is becoming steadily more perceptible.

The broadcaster may well ask how he can obtain revenue by other means. That is a phase of the situation closely allied with publicity, but it is not the immediate subject under discussion, nor can it be looked upon as the weightiest factor in broadcasting. This great enterprise has assumed a semi-public character and the stations of the nation are regarded as semi-public institutions, in the same way that newspapers and periodicals often become a vital part in the life of the times. If a newspaper or magazine, honored with the respect and confidence of the public, should so far misconceive its mission as some radio stations have been known to do, the result could not be long if it is a doubt. Broadcasters of trained perceptions admit this view, and maintain that every station must stand or fall by the rule of its own conduct. That is an excellent answer and not improbably the solution of publicity in the air.

It is not an easy matter to conduct a broadcasting station. Judging from the number of those who rush in where the initiated tread with care, a wide impression exists that the only requirements for success are represented by a microphone and a few entertainers. But the record of survival indicates that broadcasting requires something more. That something might be called a large endowment of ingenuity, because the typical program director must be ingenious indeed—if not a genius.

Within the last two years more than 1,000 government licenses have been issued to broadcasting stations. At this moment but 535 are in operation, surely a prodigious number, but still these are a mere half of those established in this short span of twenty-four months.

What became of the others? That is one of the unwritten chapters of radio, which might afford much profit to those who contemplate entering upon the high adventure of broadcasting. About sixty of the 535 surviving stations are now interlarding pub-

licity with their usual programs. These sixty stations are among the largest and best organized in the country, so it is a fair assumption that the principal support of broadcasting to-day comes from paid publicity.

ESSENTIALLY BROADCASTING IS PUBLICITY

THE definition of paid publicity is used advisedly, for some of the men identified with radio argue that the whole broadcasting activity has been built upon the theory of publicity, and maintain that the question whether this publicity benefits a station or is bought by some one using that station, does not really matter.

But there is a difference between the kind of publicity which a station obtains and the sort that deals with baked beans at so much a minute. The privilege of addressing a radio audience is worth anywhere from $40 to $600 an hour, and the man who buys even ten minutes will strive hard to sell something in his allotted time.

This question of "selling something by radio" is a particularly annoying thorn. No matter how ably theories may be argued, it is past dispute that the man who puts on his slippers and lets his mind drift away with radio, does not want to have a salesman's patter drummed in his ears. The direct sales appeal seldom is permitted by radio. Happily that has been true in a large measure, but selling organizations everywhere are turning intensive attention to the possibilities of radio campaigns. The appeal to buy seeps through the air more clearly every day. The man we have imagined in his slippers always has the opportunity to turn a dial and usher in another thought, a privilege that he undoubtedly uses to excellent advantage, but if there is to be no intelligent check on publicity, the day does not seem far distant when it will be difficult to tune-in a program without unpleasant advertising features.

VARIOUS ARE THE USES OF PUBLICITY

THERE are many sorts of publicity. Every one is familiar with the discourse on baked beans and other subjects of the kind. Then there is the variety of publicity which

THE RADIO STUDIO

May become as much a battleground for advertisers as the pages of the daily newspaper or the magazine. There are those who contend that all broadcasting is advertising for someone, and that it is merely a question of who shall be advertised and in what way. Secretary of Commerce Hoover says "the quickest way to kill broadcasting would be to use it for direct advertising." In any event, it will be the listener who decides whether or no he will countenance radio advertising of any sort. The photograph shows the studio of KGO at Oakland

ramp followers themselves do not always recognize. Upon the principle that ignorance is bliss this particular phase might seem beyond objection. The man with a radio set will not resent an announcement in which the name of some New York hotel is called to his attention by the information that its orchestra will now play for his edification. There has been a lively competition lately among hotel orchestras of the metropolis for this privilege, and some of the big hostelries are paying monumental fees in order that their names may be associated in the public minds with superior musical organizations.

THE HAPPINESS BOYS

Give a weekly program from WEAF, New York, which is an excellent example of what many consider a quite inoffensive form of indirect advertising. The only mention made of Happiness Candy Stores, which they represent, is at the start and finish of their half-hour program

This is publicity in its least objectionable form. Another variety that seems to pass muster is the address by some life insurance executive or banking official who treats of matters which lie close to the public interest. Usually the only advertising consists in the linking of names which join the company and the speaker while thousands of persons pay heed. Many of these radio addresses are so well delivered that they represent a public service rather than a private gain, no matter how large that gain may be. Other addresses are boresome to the point of drowsiness, but it does not take long for the radio follower to apply the proper and inevitable remedy.

Publicity falls into a third classification, which is insiduous and subject to criticism, the kind of publicity where the object of the speaker is withheld, seeking by adroit means to inveigle the public mind. An illustration might be found in a number of addresses delivered not long ago on the subject of a great water power development, for which public support was needed. It may be questioned whether some of the stations concerned recognized this theme as publicity, because it bore none of the usual ear marks. Program directors are ever on the alert against the man who endeavors to use their stations for publicity without pay. Perhaps some of these water power addresses were paid material; others were not. But the way in which they cropped up across the country left little doubt in the minds of shrewd observers that interest in water power served a broader purpose.

With the development of publicity we also have had the introduction and rapid advance of the radio publicity agent. He is now an established institution and likely to become as colorful a personality in the field of radio as he long since became in the domain of the press. Indications are that he will not have a higher repute in his new vocation than he has had in his old.

There is another side to radio publicity which deals frankly and wholly with advertising in its customary and recognized forms. It is said that some twenty or twenty-five of the principal advertising agencies now maintain departments which deal exclusively with the sale of merchandise by radio. Their methods are less subtle than those of the publicity agent who organizes a campaign which evolves around some public question, such as the water power rights. But let us assume that an advertising agent is retained to make popular a particular kind of silk. His first step would be to copyright some attractive name for his merchandise. Then he might send out a recognized fashion designer, delivering talks across the country on the charm of the season's new styles in silks, particularly that silk into which had been woven the skillful threads of advertising.

It is within reason to believe that all of the women who listened to one of these fashion chats would find no fault with the advertising flavor. One trained observer of public inclinations pointed out that women read the daily bargain advertisements with as much or more interest than any other section of the daily press. Therefore, why not an equal interest in styles by air?

If the answer be affirmative, it is only another step to conclude that bargains by air might be acceptable to a numerous section of radio followers. This same man, who knows all about the minds of women, even ventured the suggestion that a time would come when broadcasting stations could be operated solely for the purpose of announcing sales and fashions and such things.

Endeavoring for a moment to look down the opening vista of time with the eyes of this commercial prophet it is interesting to follow up the suggestion. If a mail order concern in Chicago made a regular Monday night announcement of special buying opportunities, it would be able to reach a multitude in ten states around, accomplishing in ten or fifteen minutes with the voice of one man what would require great organization and the applied efforts of many workers, by any other means. Although we may safely conclude that this broadcasting of bargains lies somewhat in the future, it is a possibility not to be lightly dismissed.

> ## Herbert Hoover Says—
>
> I believe that the quickest way to kill broadcasting would be to use it for direct advertising. The reader of the newspaper has an option whether he will read an ad or not, but if a speech by the President is to be used as the meat in a sandwich of two patent medicine advertisements, there will be no radio left. To what extent it may be employed for what we now call indirect advertising, I do not know, and only the experience with the reactions of listeners can tell. I do not believe there is any practical method of payment from the receivers. I wish to suggest for consideration the possibility of mutual organization by broadcasters of a service for themselves similar to that which the newspapers have for their use in the press associations, which would furnish programs of national events and arrange for their transmission and distribution on some sort of a financial basis, just as the press associations gather and distribute news among their members.
>
> It may be that we cannot find a solution at this moment, but I believe that one result of this conference should not only be the consideration of this question but the establishment of a continuing committee for its consideration."
>
> —HERBERT HOOVER, Secretary of Commerce, in his opening address to the third annual radio conference in Washington.

Broadcasting is such a comparatively new field of endeavor that its principles remain undefined and its development must be yet measured. Much of the uncertainty and many of the objectionable qualities which characterize radio were present in equal or greater measure when the automobile and moving picture industries first began their amazing expansion. Wherever there is haste and stress, there also must be growing pains. But the lusty vigor of radio and its broad application furnish abundant guarantees that its difficulties will be solved.

In the meanwhile the publicity agent is busily engaged at his task. At least two or three radio booking agencies have come into existence which undertake to [illegible] a hearing for any particular kind of ba[illegible]ze. [illegible] or some new fabric, by addresses a[illegible] [illegible]her devices employed from station to [illegible]ion. These booking agencies have worked out a schedule on much the same principle as theatrical agencies. A speaker leaving New York, let us say, will travel to Cleveland, then Chicago, perhaps Omaha, and so on to the Coast, returning by the Southern route. He will "play one night stands" and allow a few days between each address so that the tenor of his arguments do not become too familiar.

This fall has witnessed an interest in radio never before approached. It is not so long ago that observers asked if radio had come to stay and could maintain itself as an entertainment against the many other forms of appeal for public attention. That question seems trite now, although it involved serious consideration but a short while ago. With the new assurance that radio has become a definite part of American activity, men who study publicity and advertising in its varied phases have centered their efforts upon reaching the public mind by means of the microphone. And they are succeeding in a degree which opens to the broadcasters an immediate and incalculably rich source of revenue. Shall we blame the broadcaster for extending his hand to those who urge pay upon him when he has no other means of obtaining a return? Certainly this presents a case where the broadcaster must be more than human to decline. Once more the ethical and the practical clash.

The American newspapers formerly were blighted with the same sort of shadow that hangs over radio. Almost any average newspaper of fifteen or twenty years ago was

crammed with advertisements of patent medicines, liquor of many sorts, and other questionable advertising material. Then public sentiment and the perception of publishers began to raise up a barrier which has become higher than any man might have hoped. Whiskey advertisements were the first to feel this influence. Regardless of the virtues or lack of virtue involved in prohibition, sentiment agreed that the widespread advertising of whiskey was a bad thing. Even before prohibition, it was unusual to find such advertisements in the best papers. Patent medicine advertisements are disappearing. The really representative institutions of the American press exercise a more rigorous censorship over their advertising columns than any public agency could possibly put in effect. The lowly bill-board is hard pressed for its very life.

Along with the change in advertising came a decided improvement in editorial columns. The noxious "reading notice" of yesterday is almost unknown now, not only because of an ethical advance, but for the excellent reason that Congress passed a Federal statute requiring every paid article or card to be plainly marked advertisement. That law, which was stoutly contended against by many publishers, proved one of the wholesome influences brought to bear on American journalism.

To-day the question is asked if radio broadcasters should not be subject to some similar restrictions. What could be lost by a Federal statute that would compel announcers to specify advertising features on their program? This need not take an offensive form, no more than the word advertisement at the top of a newspaper column prevents readers from perusing its contents.

We are a nation of advertisement readers. Advertising long since emerged from the day when it had anything to conceal. Men who value highest the prestige and future of radio have taken note of this similarity and the question is one that will be repeated oftener—why not plainly label each program number that deals with advertising? Then the question of faith between the broadcasters and the public would be effectively settled.

There is distinguished opinion on the side of permitting radio advertising to find its own level. Secretary of Commerce Herbert C. Hoover is one of the men who inclines to this view. In a conversation not long ago with Paul B. Klugh, Executive Chairman of the National Association of Broadcasters, Mr. Hoover repeated previous statements that he saw no reason for a censorship of radio publicity.

QUICK REACTION FROM POOR PROGRAMS

"IT HAS been the experience of broadcasters that the public interest centers on the kind of entertainment provided, regardless of advertising," said Mr. Klugh. "If any station permits an advertiser to broadcast poor entertainment, both the station and the advertiser suffer. There never is much question about the reaction from a campaign of this sort. When uninteresting and badly devised, the station which permits it to go on will not be slow in hearing from followers. Methods of measuring this public reaction to any kind of appeal have become so definitely fixed that we may safely leave the problem of radio publicity in the public's hands.

"Personally I see no reason why radio publicity should be objectionable merely because it is publicity. There may be causes of specific complaint, but it is certain that no worthwhile station would permit questionable material to be radiated, once the character of this material had been established.

"Broadcasting stations are becoming so jealous of their reputation that they closely scan every number on their programs. Should any of these numbers offend public taste, the stations themselves would be the quickest and surest sufferers.

WENDELL HALL

A radio entertainer who is nationally known. He has appeared from many stations in all parts of the country accomplishing "indirect advertising" for the National Carbon Company

PAUL B. KLUGH

Executive Chairman, National Association of Broadcasters. Many of the associated broadcasters of this organization will accept radio bookings of artists or speakers who are employed to appear before the microphone in one of the various forms of indirect advertising now going out on the air. Mr. Klugh believes that a certain form of indirect advertising will be quite acceptable to the listener

"It is not enough to avoid offence; a station must always command the interest of a multitude, and we may be certain that this command is impossible when advertising material becomes uninteresting. There is no audience more exacting than that which sits at home with perhaps a dozen radio stations in easy reach. I think we need have no fear that programs will tend to the boresome or questionable so long as a man need but shift a dial to change his entertainment. It seems to me that the law of preservation and the unfailing exercise of public choice will serve to control radio publicity better than any other means we could devise."

But in any case, the listener-in himself will decide the fate of radio advertising. In this matter as in many others, it takes a considerable time for the feelings of the public to be definitely manifested. It is often difficult even to know exactly what the proper interpretation of "the public reaction" is.

RADIO BROADCAST is interested to know what its readers think of the question Mr. Young has so ably treated. A few of the best letters expressing a reasoned opinion will be published in later numbers of this magazine. Address your letters to THE EDITOR.

PRESIDENT COOLIDGE

And Secretary of Commerce, Herbert Hoover, in the grounds of the White House. President Coolidge is addressing the members of the Third Annual Radio Conference. The President described the advancement of radio as "one of the most astonishing developments in the history of science." He said radio offers the Government one of the greatest problems it has had to face, and that little change would be made in present policies. There would be no monoply of the air, he declared

THE MARCH OF RADIO

By J. H. Morecroft

President, Institute of Radio Engineers

What the Hoover Conference Did

THOSE who like to criticize Cabinet officers in the present Republican administration seem to have avoided Herbert Hoover, the able Secretary of Commerce. Almost everyone feels that Secretary Hoover has done an excellent job. And few groups feel that more strongly than the radio folk. Mr. Hoover has been in office during one of the most difficult times possible from the point of view of radio. During the early months of his office, broadcasting began with the licensing of the station of the Detroit *News*, WWJ, and KDKA, the Westinghouse station at East Pittsburgh. Troubles and complications and problems of all kinds descended upon the Department of Commerce thick and fast from then on. The best tribute it is possible to pay Mr. Hoover and his subordinates in office is that they have managed radio affairs with the least possible friction and

RADIO ABOARD THE ZR-3

The Zeppelin, which the Reparations Commission allotted to the United States Government. She recently completed the 5,060 mile flight from Friedrichshafen to Lakehurst in eighty one hours. The great ship is 660 feet long. Her radio equipment, shown in the photograph, consists of a 200 watt tube transmitter for cw and telephone, operating on 1510 meters. The fan antenna is dropped through the deck of the forward gondola, where the radio apparatus is located. The wires, each 400 feet long and weighted at the end, form a fan, as the insert of the ship shows

a great deal of tact. The regulation of radio is a complicated matter indeed.

For the last three years, there has been an annual conference to discuss and make definite recommendations about radio, called under the auspices of the Department of Commerce. Here, the lambs and the wolves have laid down together, bitter enemies have watched each other, pleasantly enough, across the quieting green baize of the conference table, and progress in the radio field has been constructively guided. The Department of Commerce radio regulations have very largely been formed from the wise suggestions of these conferences.

The Third Annual Radio Conference at Washington this year was as widely attended as those which preceded it, and although it is a bit early to draw conclusions, we think it accomplished quite as much if not more than the first two.

A brief summary of the recommendations of the Conference follows:

The amateurs are to be given a new series of wave bands, somewhat lower than those to which they are at present entitled. They are to be permitted to operate continuously, for it is believed that such operation will in no way interfere with other services. The amateur showed his willingness to coöperate by volunteering to abolish the use of spark transmitters and discouraging the use of oscillating receivers within the broadcast range. The latter is particularly important because it means that interference from squealing receivers will not exist so far as the amateur is concerned on the short waves to be used for rebroadcasting.

Ship transmitting waves are to be pushed up beyond the broadcast zone, and thus another form of severe interference has been greatly reduced. A general revision of the licenses for various types of broadcasting stations will, it is believed, result in a great improvement in broadcasting conditions.

Perhaps no one decision of the conference was more important, or considered more thoroughly, than the proposal to establish super-power broadcasting stations in several parts of the country which should be capable of broadcasting important events to all parts of the country simultaneously. There was so much feeling in favor and so much opposition to this proposal that a compromise was effected. This provided that any individual or company may apply for a license for such a station. The license will be an experimental one and is immediately revocable by the Department of Commerce if such a station interferes with any service already existing.

Such an experiment is of great importance. Several companies are ready to undertake it at once. Super-power and the victory or defeat of a group of influential radio men now hangs

in the balance. By all means let us have a fair trial and judgment of the case on its merit alone.

These are the most important recommendations of the Conference. Their crystallization and enforcement now lies with the radio service of the Department of Commerce. Most of the detail work yet remains to be done. And it is left to a pitifully undermanned and pitifully underpaid department to do. The radio service of the Department of Commerce has done marvels when one considers the handicaps under which they have always worked. Congress has steadily refused to make any appropriations other than those covering the bare necessities of operation. The entire personnel of the radio service has been for a period of years taxed beyond its strength.

If no other good results from this latest conference, it is to be hoped that there will have been spread about a greater appreciation for the level-headed, highly conscientious, far sighted men in the Department of Commerce and the Bureau of Standards.

Aside from the technical findings of the Conference, which were much more involved than those considered at any previous conference, there was one outstanding beneficial result. Radio men and women from all sections of the land met and ironed out their difficulties and got away to a new start. In this respect, the Third Radio Conference was strikingly successful.

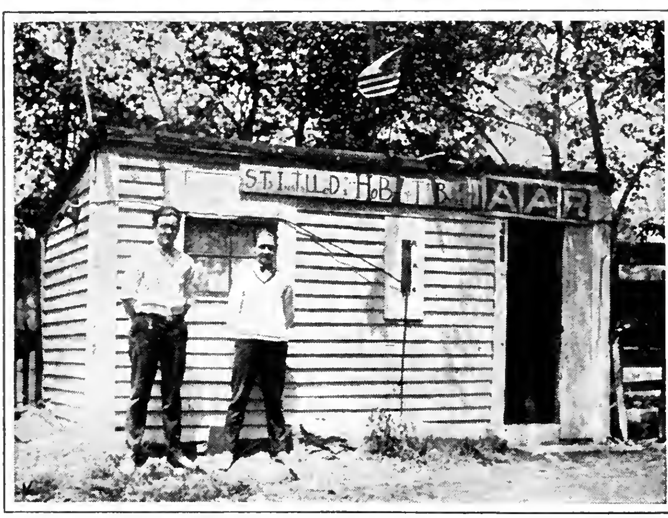
Short Waves Should Be Conserved

THE world's record for long distance communication was broken by a pair of amateurs, a Californian and a New Zealander, a short time ago. They carried on intercommunication at a distance of 6,900 miles for more than an hour employing short waves. There is something of more importance in the accomplishment of this remarkable feat than appears on the surface—something more than the mere fact that a new record has been set up.

Most engineers and most of the experienced amateurs who have been experimenting with short waves agree that we know but little about their proper use. One of the principal reasons for the increasing popularity of such experimenting is unquestionably due to the fact that much publicity has resulted from the experimental broadcasting on the shorter waves by the Westinghouse and the General Electric Companies. As a result of this publicity there has been a demand on the part of listeners-in to procure receivers capable of receiving these broadcasts for which many startling claims have been made.

Following this demand there has been the usual group of short-sighted manufacturers who have endeavored to "cash in" upon the demand. The simplest form of receiver for such operation is the common regenerator—with a few slight alterations—which has come in for so much condemnation in these columns because it not only is a receiver, but a very good transmitter when operated in its most sensitive condition.

In short wave broadcasting, we saw a means of sending programs to a group of stations, if proper facilities could be arranged. These broadcasts could then be picked up and rebroadcast on the waves we are accustomed to employ. Indeed, the experiments conducted by the two corporations to which we have referred have proved this to be so. But we foresaw in the ordinary type of regenerative receiver a menace even greater than when used on the regular broadcast waves. For this



RUSSELL AND STUART HOBART

Of Roslindale, Massachusetts, outside of their amateur station I AAR from which they recently communicated with amateurs in the Netherlands.

THE LEAGUE OF NATIONS IN SESSION

At Geneva. The President of the Swiss Federated Republic is presiding over the meeting of the General Assembly. Four microphones can be distinctly seen on the rostrum from which the proceedings were sent out for the first time

reason no "how-to-make-it" articles in RADIO BROADCAST describing one of these abominations appear.

Let us be more explicit. Nearly everyone who has listened-in on a radio receiver has at one time or another had a good concert ruined by some improperly operated oscillating receiver, operated in his vicinity. In this case the interference from the offending receiver is confined to the neighborhood in which it is operated, which is bad enough. Where short waves are used in place of wires to carry a concert from one point to another where it is to be rebroadcast, it is but necessary to have one such improperly operated receiver completely to ruin reception for those, not only in the immediate vicinity of the offender, but for all served by the station doing the rebroadcasting.

It was not until we could perfect a receiver capable of efficient operation on short waves without causing interference that we would publish any instructions for building receivers with which the short wave broadcasts could be picked up. It is particularly gratifying to us, therefore to have designed the receiver with which this remarkable record was made. Perhaps some of those readers who were somewhat disgruntled at our deliberate refusals to give them the information on such receivers they sought most diligently will now appreciate the reason for our stand. If they do not, we feel perfectly happy in having endeavored to serve the greatest number to the best of our ability. Needless to say we are deeply grateful to Mr. W. B. Magner, the Californian who made the record with the Roberts short wave two-tube receiver described by Zeh Bouck in our August number.

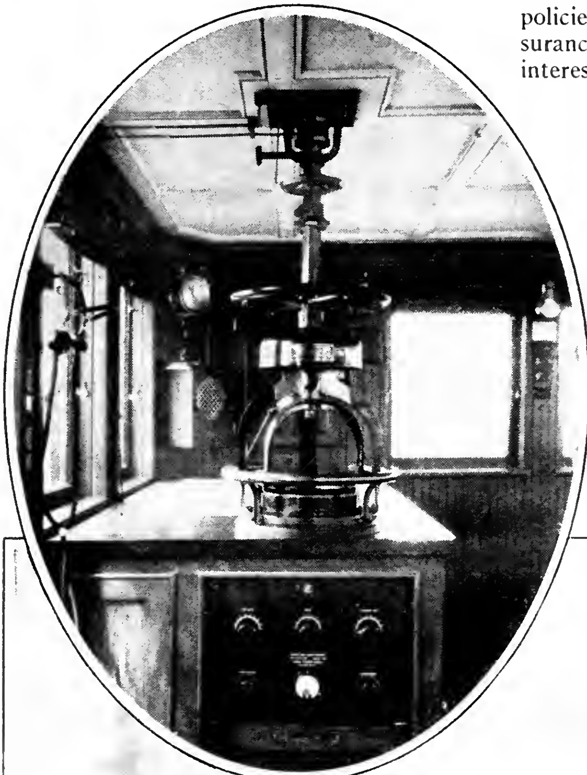
Farmers Really Use Radio

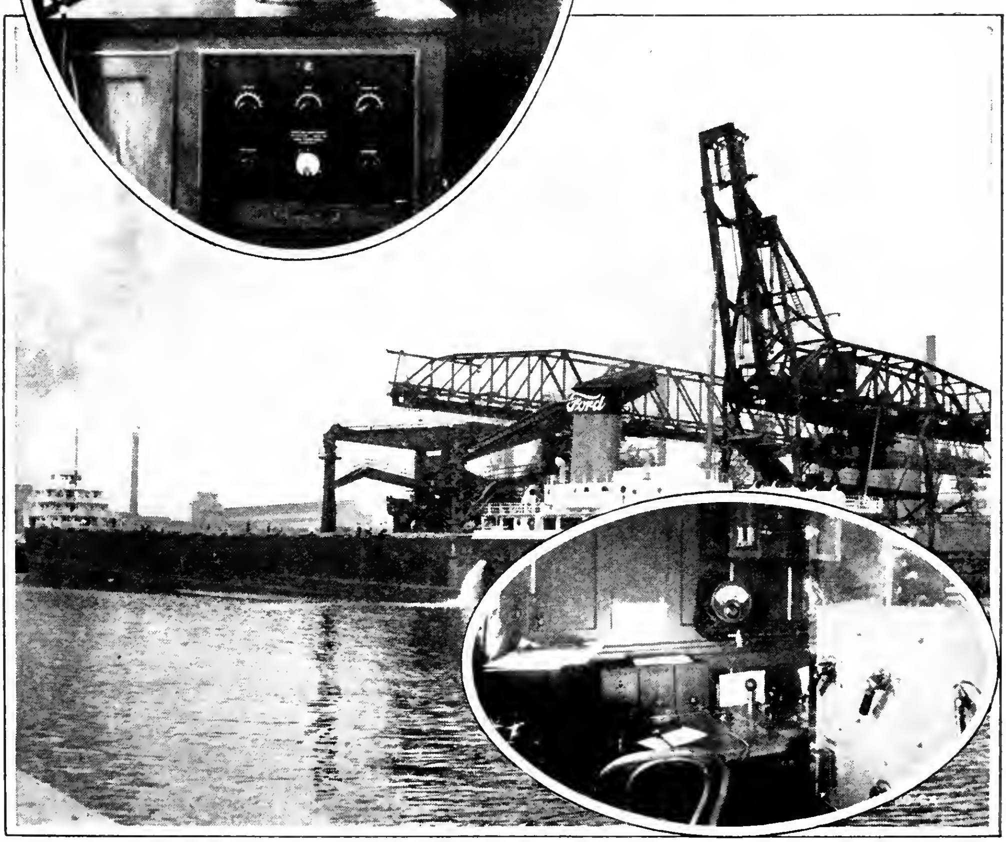
WE HAVE often speculated on the farmer's use of radio, assuming that market reports and similar news items over the radio channel must be of real value to him. Thus far the farmer has not been very effusive in expressing his appreciation of the "farmer's radio channel." A news item from Milwaukee states that the farmers in the neighboring section have banded together to prevent the erection of electric power lines through their property, claiming that the presence of the high power wires "would make

it almost impossible for them to receive market reports and other news by radio because of interference." One must certainly conclude from this apparently dependable report that the farmers in this section at least are making real use of the news which radio is disseminating.

The Narrow Radio Ruling of the Insurance Companies

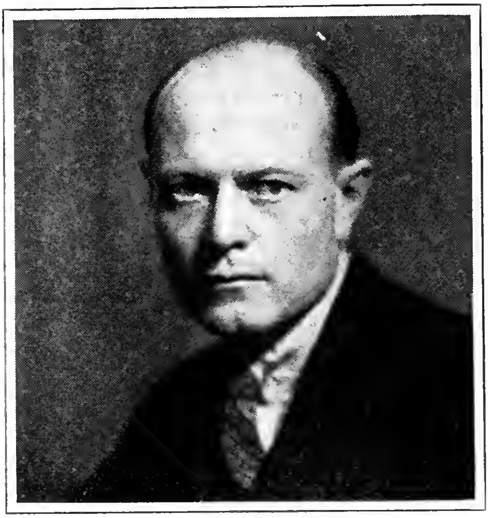
THE fire insurance companies have taken cognizance of radio installations by attaching a radio permit to their policies. We have just received the one attached to policies issued under the New York Fire Insurance Rating Organization, and note with interest one of its clauses. After stipulating





HENRY FORD'S MARINE RADIO EQUIPMENT

Aboard the SS. *Benson Ford* at dock in River Rouge, Michigan. The ship is one of two, built to carry bulk cargo to and from the Ford Detroit plants. Onthe dock can be seen gondola freight cars of the D. T. & I., the Ford railroad. The *Benson Ford* is equipped with a 500 watt RCA cw transmitter, operating on 600, 706, 909, and 1875 meters. KFTC is also equipped with a radio compass which the photograph shows installed on the bridge. Both the new Ford ships use radio telephone as well as the telegraph. The master of either ship can talk directly from his cabin to any other ship within range by telephone



—Nicholas Muray

KARL BICKEL

New York City; President, the United Press

"Inch by inch radio is edging into the business of news distribution. This was never so graphically illustrated as in connection with the Democratic National Convention. Extra editions rushed from New York to suburban towns carrying the 71st ballot would reach the newsstand just as the complete report of the 80th ballot was coming over the loud speaker. The editions were old before they arrived.

"The results of big sports contests are now known instantaneously via radio. However, in spite of these instances, I do not believe the newspapers have much to fear. But radio can never give the complete news report of the day as the newspapers can give it.

"Radio is an imperative thing. Unlike the newspaper, it cannot be laid aside and picked up in a moment of leisure. You miss the event if you are not at the loud speaker as it is being broadcast. And even then you get only the fact. The newspapers are read for color and interpretation. With big news being flashed by radio, newspaper publishers will no longer have the obligation of going extra to give the public the news. More time and effort can be spent on improving details and interpreting the facts.

"Press associations will not enter the radio field by erecting their own broadcasting stations for the distribution of news in the immediate future. Popular radio telephony is still an infant industry of only three years' growth and has by no means exhausted the possibilities of its development."

that the policy does not cover personal injury from electrical apparatus, etc., a warranty states that "the source of energy shall be only from primary or storage batteries."

One could almost believe that this clause was written at the request of the battery manufacturers. We are extremely irritated by this clause, for it seems to penalize advances in the art. The idea of depending upon batteries for the power to run a radio receiver when electric power is used in a house for lighting, is really very absurd from the engineering point of view. We have continually advocated the use of suitable rectifying outfits so that the power may be obtained from the light socket, with the view of stimulating the inventive genius of the country along these lines, and now the insurance companies have put themselves in the position of penalizing such devices!

There is no reason in the world why these rectifying outfits, properly designed, built, and installed, should be discriminated against. We certainly hope the ill-advised insurance companies will eliminate the progress-impeding clause from their policies.

The Chicago Municipal Radio Commission

FEELING that the conditions in the broadcasting game in Chicago were not as satisfactory to the average listener as they should, and might, be, Chicago's mayor has appointed a committee of representative technical and business men to study the problem and hand in to him their findings and recommendations. The idea of forming such a commission belongs to Frank Reichmann, president of the Reichmann Co. He has felt that such a commission might do much to control the possible censoring of broadcast stations, and to arouse and crystalize public opinion against oppressive local legislation having to do with radio matters. Of course no real power can be assumed by such a commission. Its function is entirely advisory. The control of radio must necessarily come under the Federal Government, as it surely is "interstate traffic." Some municipalities have enacted statutes which purport to dictate on radio matters insofar as their community is concerned, but such statutes are probably of no real importance.

Speaking of the work this Chicago commission will undertake, the minutes of its first meeting conclude "Another important reason for a radio commission is the fact that in the last few years practically every form of popular entertainment enjoyed by the people has been subject to attack from small minority groups, who seek to regulate by sumptuary law every minute of our lives from the

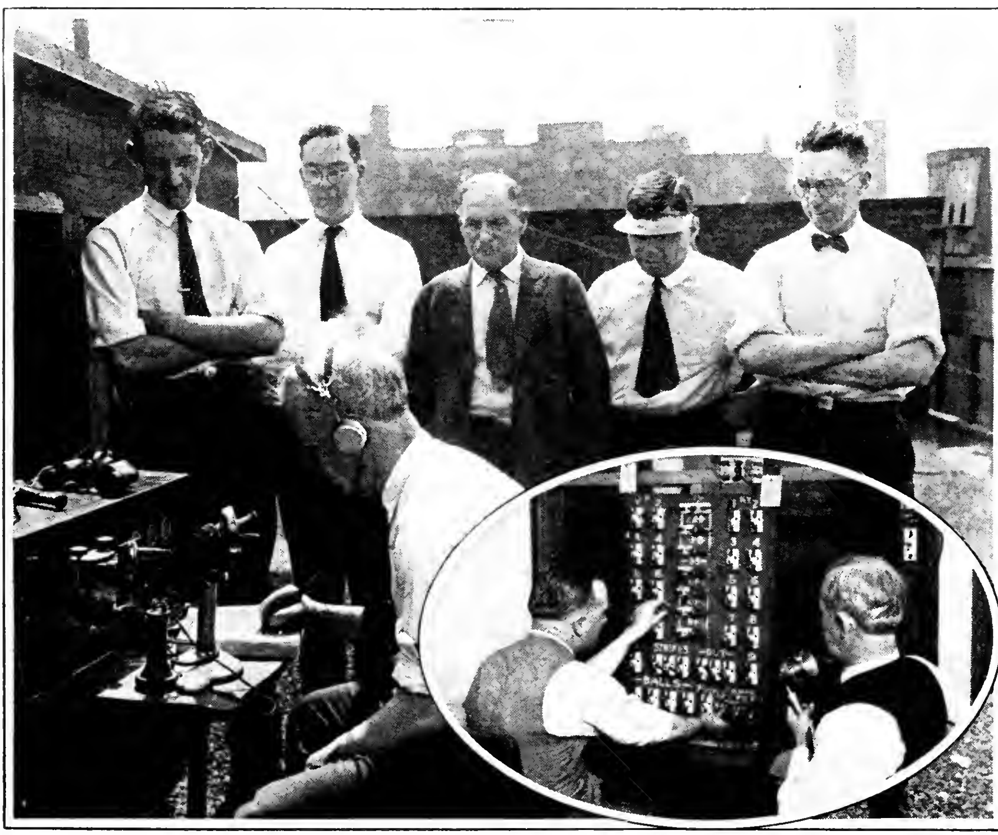
cradle to the grave. A commission operating efficiently can shield the radio listener and the broadcaster from these attacks and can do a great deal to prevent oppressive legislation."

Broadcasting is Publishing

MUCH has been said lately about the use of a broadcasting station for advertising purposes. The majority of listeners, we think, vehemently protest against listening to purely advertising programs. It seems as though advertising in some form or other must be indulged in by broadcasting stations until some better method of raising an income is devised. Looking for an analagous situation, the newspaper at once appeals to us as having a similar problem. We buy a newspaper primarily to get the news, but unless the paper carries a great deal of advertising we would have to pay probably ten times the present price to get the news The advertising of any paper or magazine pays for a very large share of its operating expense and unless a broadcasting station is suitably endowed we must naturally expect to get quite a lot of advertising in its programs.

The listener however, isn't really as badly off as the last sentence might lead one to believe, because radio advertising must be of a high order of merit, for otherwise no one will listen to the station. The reaction is sure to be just the same as was exhibited by a motorist whose view of a beautiful wooded valley was completely shut off by a glaring sign purporting to give the merits of Pinnacle Oil for engines. "Damn the company that puts up signs like that to cut off such beautiful landscapes, said he. "I'll never buy any of their oil, no matter how good it is."

It sometimes happens, however, that one has to listen-in to a program which is quite



RADIO WITH THE SCRANTON "TIMES"

During the World's Series games. The insert shows the electric scoreboard which was operated simultaneously with the radio loud speakers. When the Navy dirigible *Shenandoah* flew over Scranton recently, the *Times* radio station, WQAN, was in communication with the ship for more than two hours

evidently advertising matter, yet the announcer has said nothing to that effect in introducing the number. One at once feels he is being hoodwinked—something is being "put over." The reaction of the listener to such material is just opposite to that which the advertiser is endeavoring to arouse, so that advertising of this nature is likely to be practised to an ever diminishing extent. The listeners themselves, we think, are apt to be the court of last resort.

Another phase of the question is however brought to the front by a paragraph in the "Topics of the Times" in New York *Times*, drawing an analogy between advertising over the radio channel and by means of the press. It is illegal for a newspaper to put advertising material in its columns without so designating it, and there is no reason at all why the same rule could not apply to radio. In the words of the editorial writer, "Broadcasting certainly is publishing, and all publishing should be honest. Newspapers, or at any rate some newspapers, including one which modesty prevents mentioning, did not wait for the law to speak on this subject but put "advertisement" over all advertisements not obviously that, to every eye. That virtuous example, the broadcasters would do well to imitate voluntarily. The sooner they do it, the less likely will they be to suffer later from regulations that will be really burdensome.

Bureau of Standards Finishes Tests

THE Bureau of Standards has just brought to a close a series of tests which it organized with the idea of ascertaining as much as possible about fading, interference, effects of weather, etc. Some 200 observers located at varying distances, from the two stations chosen for transmitting (KDKA and WLAG, now WCCO) turned into the Bureau about 50,000 observations. These observations are to be tabulated and classified, and it is hoped they will throw some light on the complex problem of radio transmission.

A task of this kind entails a tremendous amount of work on the small and hard working radio staff of the Bureau, and we cannot but express our appreciation of their work in the interests of radio progress. The standard frequency transmission schedules inaugurated and carried out by the Bureau are, in our opinion, a genuine contribution to radio developments and we are glad to voice the thanks of the millions of BCL's for that useful service.

WGY ON WHEELS

This small truck is equipped with a low powered short wave transmitter which picks up programs from churches and public halls. The main station at WGY picks up these signals and they are radiated in the regular manner. The small transmitter takes the place of the usual telephone line connection between the outside hall and the broadcasting station

Radio and the World Flight

OUR world encircling planes have recently completed their 27,000 mile flight and are receiving the congratulations they so well deserve. Besides the intrepidity of the air men themselves, many factors contributed greatly to the success of the experiment, not

the least of which was the radio channels with which the airmen were continually in touch. When crossing the northern part of the Pacific, the radio problem was of extreme importance. As almost everyone knows, the weather conditions here are continually unsettled and the danger threatening a lost aviator is very imminent. In just this part of the world, there is precious little radio equipment, for between Dutch Harbor in America, and Japan, there is not a single radio station.

To the Coast Guard cutter *Haida*, and her radio staff fell the burden of carrying on the radio traffic required by the planes during this, the most perilous part, of their route. In a recent report from the radio officer of the *Haida*, we read a fascinating story of the technical difficulties which the task entailed, and of the great importance of the radio channels he maintained in operation. As he says:

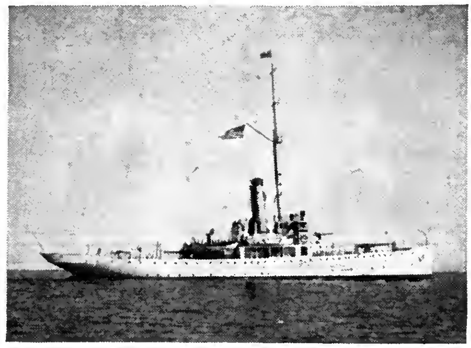
> Radio was imperative and vital to the success of the flight. There were three principal reasons.
>
> First, the planes were hopping from 300 to 700 miles in a jump. It was necessary to know the weather conditions along the line of flight. These conditions had to be known early in the morning so that the flight could start as soon as possible.
>
> Second, if one plane fell during a hop, the other planes were to proceed to the nearest radio station and drop a note telling about the accident. This made it possible to send assistance within a very short time.
>
> Third, publicity. The flight would have been of little value if the people of the United States were not informed of its progress. This news was wanted by all the various news organizations of the country. Radio was the means of getting the news over.

The log of the *Haida* graphically relates how well these three ends were met, and reflects great credit upon her staff.

Radio Movies Are Not Yet

IF WE can believe some of the news items dealing with station WMAF, operated as a pastime by Col. Green, remarkable developments are being carried on there. More than $500,000, we learn, has been spent by the Colonel on his radio hobby, and that he is riding it hard at present is indicated by the fact that he has borrowed three radio experts from the Massachusetts Institute of Technology to experiment for him at his South Dartmouth station.

According to his secretary, this wealthy radio amateur is working on the problem of projecting moving pictures by radio. It is only a few weeks past that we were congratulating those inventors who have succeeded in transmitting still pictures by radio, but even so, the transmission is still far from perfect. It takes several minutes now to transmit a "still." How, then, can the Colonel project moving pictures, which must flash on and off the screen about twenty times a second? With lots of experts and lots of money to buy apparatus and facilities, the Colonel may go far



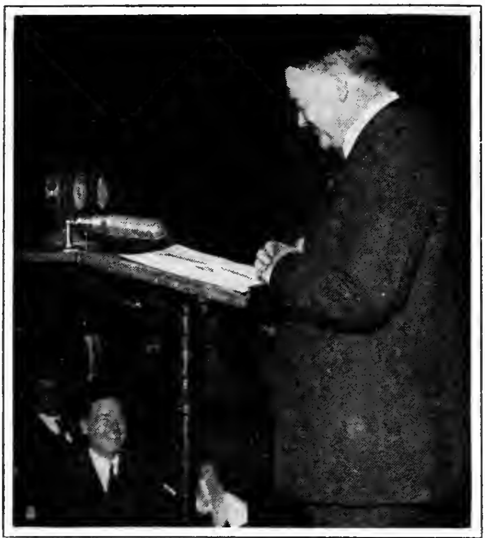
U.S.C.G. "HAIDA"

In the Bering Sea service, whose radio equipment, ably operated, was of enormous service to the Army World Fliers when they crossed to Japan

in the experimental game; that he is even attempting movies by radio would lead one to conjecture that his workers have discovered a process a thousand times as rapid and effective as that announced by the press with glee only a short time past. As no details of the scheme were given out, in the interview reported, we can make no judgment at all regarding its reliability.

Interesting Things Interesting People Say

ARTHUR CAPPER (United States Senator from Nebraska; in an interview in *Printer's Ink*): "It seems almost superfluous to comment on the obviously demoralizing and deceptive practise of broadcasting disguised indirect advertising for which the radio station has received a fee. For some years now it has been illegal for a newspaper or magazine to publish anything in paid-for space without indicating unmistakably that the matter is paid advertising. The laws were passed because the practise of disguising advertising as "reading notices" or news matter was considered an imposition on the public and a deception. And the broadcasting of paid-for indirect advertising without a clear statement of the fact at the beginning of every



© Henry Miller

HERBERT HOOVER

Washington; Secretary of Commerce

"In the whole history of scientific discovery there has never been a translation into popular use so rapid as radio telephony. So late as the year before I became Secretary of Commerce there were no broadcasting stations. At the end of four years, 530 are in operation, making radio available to every home in the country. The sales of radio apparatus have increased from a million dollars a year to a million dollars a day. It is estimated that more than 200,000 men are now employed in the industry, and the radio audience probably exceeds twenty millions of people.

"Let us not forget that the value of this great system does not lie primarily in its extent or even in its efficiency. Its worth depends on the use that is made of it. It is not the ability to transmit but the character of what is transmitted that really counts. Our telephone and telegraph systems are valuable only insofar as the messages sent from them contribute to the business and social intercourse of our people. For the first time in human history we have available to us the ability to communicate simultaneously with millions of our fellowmen, to furnish entertainment, instruction, widening vision of national problems and national events. An obligation rests on us to see that it is devoted to real service and to develop the material that is transmitted into that which is really worth while. For it is only by this that the mission of this latest blessing to humanity may be rightly fulfilled."

message that the speaker has paid for the privilege of broadcasting, is no less a deception and an imposition as far as the public is concerned."

HERBERT H. FROST (Chicago; President, the Radio Manufacturers' Association): "Between the time we first decided on the Association and the time we had effected the permanent organization, we had to go through the tax fight in Washington. The proposed tax of ten per cent., collected at the source, would have meant an increase of more than twenty per cent. to the consumer and would have cost the manufacturers many thousands of dollars in accounting, etc. That fight taught us that the interests of the manufacturer, the listener, and the broadcaster are identical. We are organized, the listeners are organizing, and so will the broadcasters. Then all can work together with the other elements in the industry to prevent these attacks."

JOSEPH M. LEVINE (New York City; President, the Hunts Point Hospital): "We have spent a half million dollars in making this institution the most modern of its kind in the Bronx district. Its equipment, from the operating rooms down through the entire plant, is the most modern and scientifically perfect obtainable. And yet, I do not believe that there is a single modern feature that can compare, in its ultimate effects for good upon the patients, with the radio installation."

FEDERAL JUDGE KNOX (New York City; in his decision in the case of Jerome H. Remick Co., vs. the General Electric Co.): "So far as the practical results are concerned, the broadcaster of the authorized performance of a copyrighted musical selection does little more than the mechanic who rigs an amplifier or loud speaker in a large auditorium to the end that persons in remote sections of the hall may hear what transpires on its stage. Such broadcasting merely gives the performer a larger audience and is not to be regarded as a separate and distinct performance of the copyrighted composition on the part of the broadcaster.

"When allowance is made for the shrieks, howls, and sibilant noises attributable to static and interference, the possessor of a radio receiving set attuned to the station of the broadcaster of an authorized performance hears only the selection as it is rendered by the performer. The performance is one and the same whether the listener-in be at the elbow of the leader of the orchestra playing the selection, or at a distance of a thousand miles."

DAVID SARNOFF (New York City; Vice-President and General Manager, Radio Corporation of America): "There is not to be found abroad the same freedom from censorship and restriction which exists here. For example, in England, where freedom of speech has been such a heralded tradition, political broadcasting is forbidden over the radio stations, which are all controlled by the British Post Office. In other European countries, Governmental regulations and restrictions are even more severe. Radio freedom . . . enjoyment, and instructive information is available to all in the United States. "I endeavored to interest the British, French, and German broadcasters in the idea of increasing the power of their sending stations, so that the programs of London, Paris, and Berlin might be easily heard by the American listening public. . . Much interest was shown in these proposals, and I believe that an era of transoceanic broadcasting is near at hand."

STABILIZING THE THREE-TUBE KNOCK-OUT

THE multi-tube reflex receiver, while opening unusual possibilities in efficiency per tube, unfortunately increases the tendency toward instability and howling. This tendency is noticeable in the three-tube knock-out receiver described in the February, 1924, issue of RADIO BROADCAST which is fundamentally the one-tube knock-out reflex plus two stages of transformer-coupled audio amplification. In the original set, a stabilizing condenser and shielding were resorted to in an endeavor to eliminate the squealing that was particularly evident when the dials were approached for tuning. Though these precautions are effective when the adjustments are made by an expert, many of our less experienced readers were unsuccessful in their efforts to stabilize the set.

More recent experiments in the R. B. LAB have efficiently stabilized this three-tube arrangement by substituting one stage of resistance-coupled amplification for the final step of transformer coupling. Non-inductive resistance-coupled amplification is fundamentally more stable than either transformer or impedance coupled intensification owing to the practical elimination of inductance (the many turn iron core windings) which is directly and indirectly responsible for most of the feedback and resulting howling in the two last named systems of amplification.

The substitution of resistance-coupled amplification also results in noticeably improved quality. Volume, though still very satisfactory, is naturally less than the output of a straight transformer-coupled amplifier.

The circuit of the improved arrangement is shown in Fig. 1. The inductances T1 and T2 are those described many times and recommended for single-tube reflex receivers. Briefly, they consist of secondaries wound with sixty-two turns of about No. 22 wire on a two and a half inch form. The primaries are wound over the secondaries with an insulating layer of paper between. The primary of T1 is wound with sixteen turns of No. 22 wire, and that of T2 with thirty-six turns of the same conductor. T3 and T4 is any efficient amplifying transformer, preferably of a medium ratio, such as four to one. A C or bias battery of one and a half to three volts is recommended in the grid return of the first stage of external audio amplification.

The crystal detector used in the set under discussion is a Pyratek fixed crystal, but may be any other reliable make.

The coupling condenser C4 is a .006 mfd. Micadon, and the coupling-resistor has a resistance of one hundred thousand ohms. This last may conveniently be either

What the Lab Offers You This Month

Hints on Stabilizing the Three-Tube Knock-Out Receiver.
A Soldering Iron for Delicate Work.
An Example of De Luxe Cabinet Construction.
Light on an Electrical Puzzle in the Filament Circuit.
Some New Ideas in Spider Web Coil Construction.
Building Your Own Lab.
Other Items of Laboratory Interest.

a Daven resistor, or a Crescent Lavite. With almost all tubes the grid leak should have a value of fifty thousand ohms.

In the set illustrated in Fig. 2, a Daven resisto-coupler was employed in rebuilding the final stage. The resisto-coupler clips the two resistances and the coupling condenser into a single unit which is connected exactly in the same manner as the transformer, the posts being marked P, B, G and F—thus permitting the change to be made in less than five minutes.

A potential of 135 volts was used, in the R. B. LAB, on the plates of the UV-201-A tubes. If the voltage is under one hundred, an additional 45 volt battery is recommended to be included in the plate circuit of the resistance-coupled amplifier at X.

Panel layouts and a more detailed exposition of constructional data on this receiver will be found in past numbers of RADIO BROADCAST—particularly the February issue.

At the same time the experiments described were being made, a final stage of impedance-coupled amplification was also attempted with similar hopes of eliminating feedback and squeal. These last experiments, however, were unsuccessful, for resistance-coupling proved the more effective prevention.

SOME POINTS ON DELICATE SOLDERING

DELICATE soldering, and soldering in places inaccessible to a large iron are trying feats that continually confront the radio experimenter, and are best accomplished with a small, specially designed light iron. Figs. 3 and 4 illustrate a soldering finesse which Raymond B. Wailes has found to facilitate delicate work. Fig. 3 shows the construction of a small iron that can be put together in a few minutes. The "iron" itself is an eight- to ten-inch length of copper or brass rod, thrust into four corks as a heat resisting handle. The tip of the iron should be filed into a square point. In the R. B. LAB, the rod was a piece of number four copper wire.

Owing to its smallness, an iron of this type will not hold its heat for any length of time. If the job is one that demands a continued application of a hot iron, it is best accomplished by applying the heat continually to the rod from a small alcohol lamp as suggested in Fig. 4.

In delicate soldering, such as the terminal wires of amplifying transformer windings and jack connections, it is essential that a non-acid flux be used. Soldering flux made by neutralizing hydrochloric acid with zinc is conductive and occasionally corrosive, as are most commercial fluxes. Mr. Wailes, and radio experts in general, recommend a flux made by dissolving rosin in denatured alcohol.

THE RADIO SET AS A WORK OF ART

THE more bona fide broadcast receivers—to discriminate from the sets purchased or built by experimenters—are slowly drawing away from the old wireless traditions of business-like switchboards and death-chamber control panels. The cabinet maker and artist

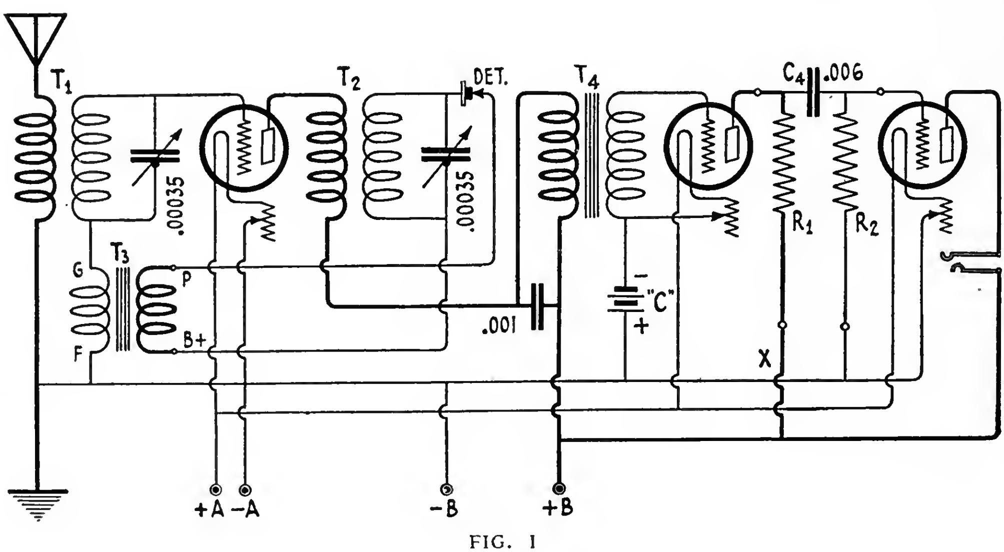


FIG. 1

The stabilized three-tube receiver. Resistance-coupled amplification has been substituted for the final stage of transformer audio

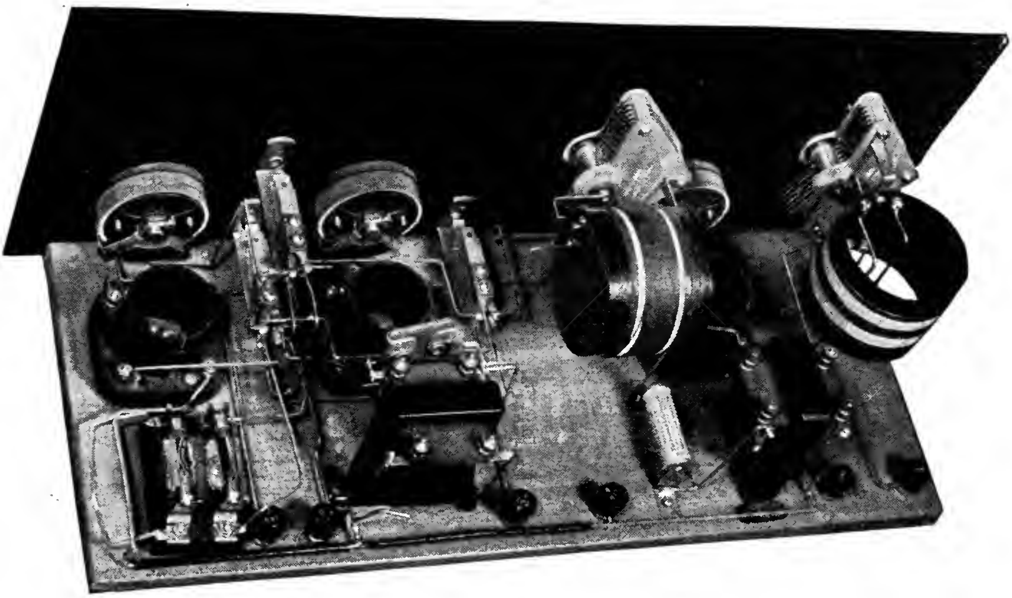


FIG. 2
Showing the change that can be made in five minutes

has come into his own, and our parlor radio sets are to-day as unlike their war-time prototypes as an expensive Victrola is unlike Edison's early machines.

A beautiful bit of furniture built about a neutrodyne receiver is shown in Figs. 5 and 6. The electrical and mechanical details were supervised by Hugh B. Downy, the owner of this work of art. The set itself is constructed with Workrite De Luxe parts. The cabinet is of solid figured oak especially selected from the stocks of the Frank Purcell Walnut Lumber Company, and built to order by the International Equipment Company of Kansas City, Mo.

It is seldom that the construction of even a de luxe radio set is subject to such painstaking care. It is a most modern example of doing a worth-while thing well.

ONE SWITCH IS NOT ENOUGH

AN INTERESTING circuit condition has been brought to our attention by Mr. James C. Millen, which at first glance seems to defy the electrical axiom that only one switch is required to break a circuit. This momentary puzzle is encountered whenever two tubes of dissimilar filament potentials are operated from a common A battery, the lower filament voltage being secured by tapping. Such a circuit is shown in Fig. 7, in which the tubes are a WD-11 (detector) and a UV-199 (audio amplifier), operating respectively from filament battery potentials of three and four and a half volts. This is a common and desirable combination. A single A battery switch has been included in the common lead, which at first glance seems adequate. Such, however, is not the case, as careful tracing of the filament circuit will disclose.

When switch S is open that portion of the filament battery bracketed by A will still discharge through the filaments connected in series—a continuous drain that will rapidly deplete that portion of the battery. No variation of similar connections (even separate A batteries) can get away from this unsuspected and doubtless very prevalent leakage.

There are three possible solutions to the puzzle. The most desirable is the use of a

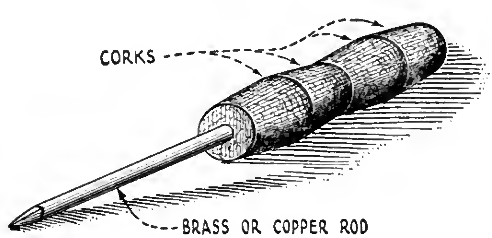


FIG. 3
A simple soldering iron for delicate work

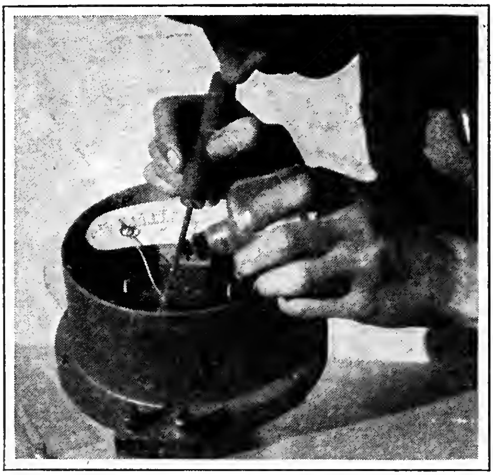


FIG. 4
Applying heat continually to a small iron

high ohmage rheostat in series with the filament of the lower voltage tube, thus permitting it to be lighted from the entire battery. A second possibility is to turn *off* one of the rheostats when the battery switch is open. The last consideration is to include an additional switch at some point such as X.

This little problem will doubtless locate the mysterious drainage in hundreds of cases of short-lived A batteries.

SOME NEW IDEAS ON SPIDER-WEBS

IN THE majority of spider-web inductances where two windings such as primary and secondary are incorporated on a single winding form, the upper winding is wound directly over the lower coil. This necessarily results in tight coupling which is often undesirable. In many cases the spider-webs are substituted for the more conventional tubular or solenoid inductances in which spacing between the windings has effected a looseness in coupling that was more or less essential in the circuit for which they were designed. This is especially true of single-tube reflex circuits, and any other systems in which selectivity is not a predominant characteristic.

In such circuits, the primary and secondary windings should be separated as far as is consistent with a negligible loss in signal strength. This loosening of coupling is quite as easily effected in spider-webs, merely by winding a dozen or so turns of string between the primary and secondary. Figs. 8 and 9 show coils in which the adjacent windings have been separated in this manner.

In Fig. 9 the primary has been wound between halves of the secondary—a procedure which tends to tighten coupling. However the placing of the primary in this manner is desirable, particularly in an endeavor to duplicate the inductance of a known solenoid without recourse to formulas and mathematics.

Referring to Fig. 9, the average radius, R, should be the radius of the solenoid or single-layer inductance that it is desired to duplicate. The primary and secondary should be evenly distributed on each side of this radius—as illustrated in the photograph—winding to the same number of turns as were on the tubular coil. The finished spider-web will, for all practical tuning purposes, be equivalent to the original solenoid.

LIGHTING THE ROBERTS SET FROM A. C.

DESPITE the fact that the UV-201-A tube consumes only one quarter of an ampere, the more enthusiastic operators of the Roberts

FIG. 5
An aristocratic bit of parlor furniture

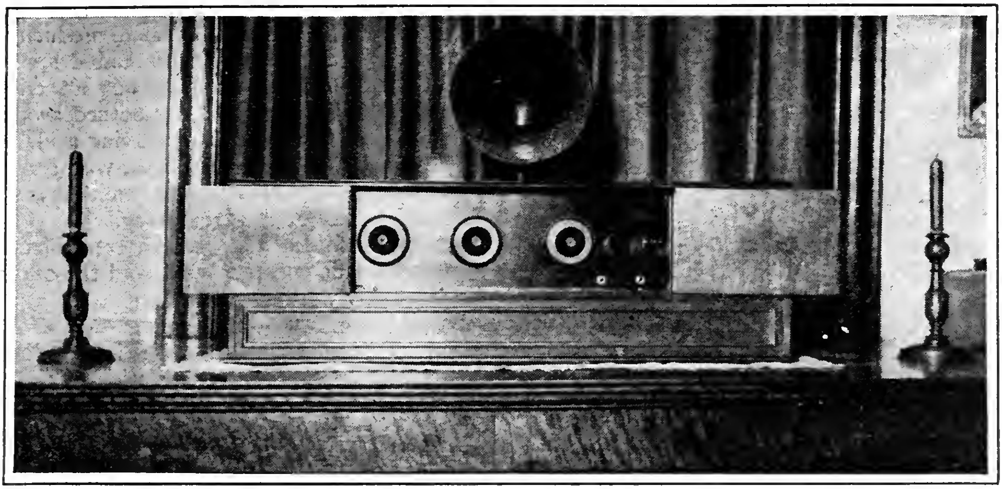


FIG. 6
The work of art open

set, inveigled by its excellence into running it five or six hours a day, find the A battery expense far from negligible. The short life of the amplifying A battery suggests the possibilities of A. C., and Fig. 10 shows the system evolved by George B. Larkin. Similar arrangements have been employed in this laboratory at various times, and confident of the possibilities and success of the system, we recommend it to our interested readers.

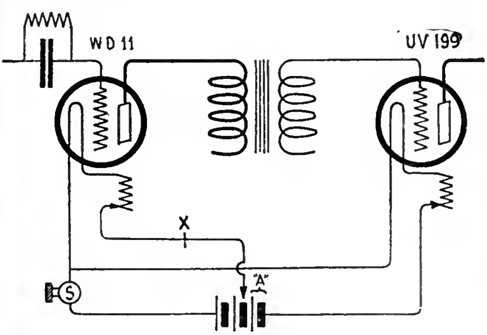


FIG. 7
This circuit will drain your A battery in a day or so if the filaments are turned "off" merely by opening the single switch

Inspection of the diagram discloses no fundamental variation from the original two-tube Roberts circuit, and for constructional details, the reader is referred to the May 1924 issue of Radio Broadcast and several subsequent numbers.

The parts required for the change to alternating current are: two twenty-five or thirty ohm rheostats, two six-ohm rheostats (one of which will probably be found in the experimenter's original receiver), and a toy transformer operating from the lighting current and delivering from six to eight volts. A

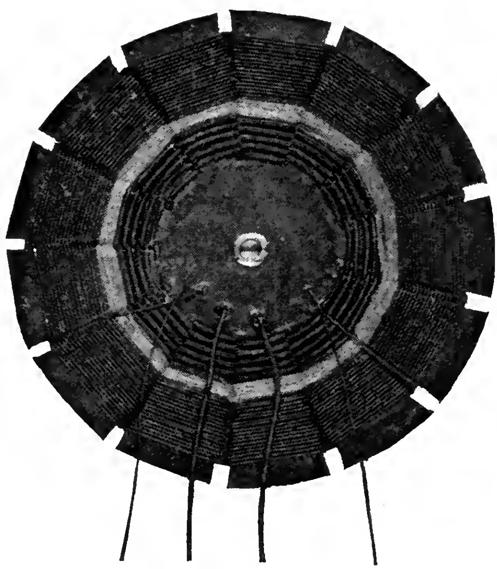


FIG. 8
Coupling is loosened by winding thread between primary and secondary

potentiometer (100 to 400 ohms) may be substituted for the two twenty-five ohm rheostats with improved results.

Balancing out with the two twenty-five ohm resistances as suggested in the diagram re-

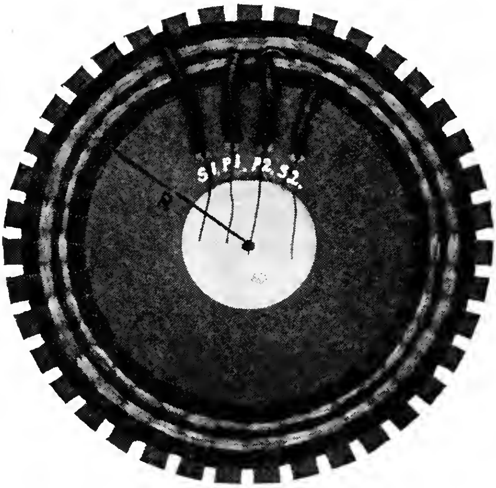


FIG. 9
Duplicating (roughly) a solenoid in a spider-web—coupling again being loosened with thread winding

duces the A.C. hum until it has little or no effect on loud-speaker operation, though it is still audible on head phone reception and interferes slightly with DX signals. This last objection may be done away with, however, by using the potentiometer recommended in place of the two rheostats. The two terminals of the potentiometer are connected respectively to each side of the transformer secondary, Y and Z, while the movable arm connects to X. X is varied until the hum is eliminated or reduced to a negligible minimum.

The action of the receiver can be still further improved by connecting two bypass condensers, of capacities from .006 mfd. to 1.0 mfd., between X and Z and X and Y, as suggested tentatively by the dotted lines.

It will be observed that the UV-199 detector tube is still lighted from a dry cell A battery. The current drawn by this tube is only six one hundredths of an ampere, and such operation is quite economical and more efficient.

BUILDING YOUR OWN LAB

THE R. B. LAB suggestion for this month's addition to the growing radio workshop is a small metal frame plane. This will cost anywhere from $.75 to $1.50. As usual, do not compromise with quality. Since this tool is more or less associated with carpenter work it is seldom thought of as an efficient aid in the radio laboratory. It is nevertheless a very useful all-around tool, and will find a wide application—smoothing the edges of rubber, bakelite and fiber panels, finishing baseboards, refinishing cabinets and producing the desired neatness in board-mounted apparatus. Rough edges on almost any material excepting metal are quickly smoothed away.

The plane should be small, having a blade no wider than an inch and a half, with screw adjustment. Fig. 11 shows a plane that is in constant service at this laboratory.

It is a good idea to obtain an extra blade, using one blade only for wood, and the other for less easily worked materials.

DON'T use enameled wire in winding spider-webs. The construction of these coils imposes a comparatively high mechanical strain on the insulation which often scrapes the enamel on touching portions of adjacent turns. This shorted turn will render the receiver practically inoperative. Double silk-covered wire is recommended for spider-web windings.

If your receiver—a Roberts for instance—is giving results considerably inferior to those you have a right to expect, and careful circuit tests fail to locate the difficulty, change spider-webs, preferably rewinding with the wire suggested.

MANY sets fail to cover the wave range specified by the original builder, and do not tune either to the upper or lower limits

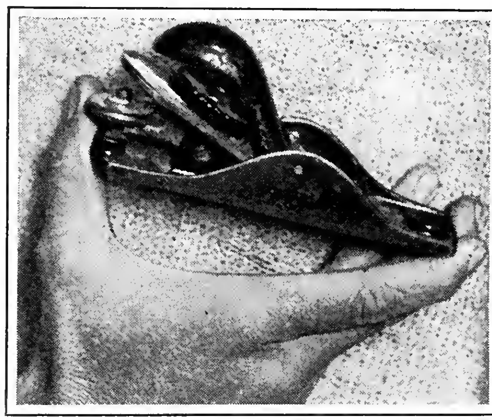


FIG. 11
The small plane has many uses in the radio workshop

or both. When the inductances (coils) are correctly wound, the fault generally lies in the variable condenser. A high minimum capacity makes it impossible to tune low, while a maximum value below the stated capacity of the condenser cuts off the higher wave lengths. Both faults are common in cheap

condensers. Ask for condensers by capacity (not by the number of plates) and accept none but those of reliable make.

THE intermediate frequency amplifier transformer used by Mr. Alan T. Hanscom in his "Six Tube Second Harmonic Super-Heterodyne" may be obtained direct from Harris and Mowry, Woonsocket, Rhode Island. These coils are too intricate and difficult for the average builder to wind, and that is the reason they were not described.

The names of other dealers carrying these coils may be found in our advertising pages.

A SCREW-DRIVER can generally be made into a convenient reamer without affecting its efficiency as a screw driver. It is merely necessary to file the converging edges to scissor edges, finishing with an oil stone. Different sized screw-drivers will be used for larger or smaller reamers—virtually adding tools to the lab equipment without increasing its already rather extensive array.

IT OCCASIONALLY happens that the primary and secondary terminals of an audio-frequency amplifying transformer are reversed in assembly, which in several cases brought to the attention of the R. B. Lab, have been the cause of the non-operation of reflex sets. In shielded transformers, it is impossible to determine the correctness of terminal connections by inspection. Measuring the resistance of the windings however, or merely testing with telephone receivers and a few dry cells, will identify the windings, the lower resistance or louder click indicating the primary.

If careful inspection of wiring of a reflex receiver, and other logical efforts at trouble shooting are without positive result, test the transformers as suggested, before rebuilding.

IN USING tickler regeneration, remember that approaching the tickler coil to the secondary will increase signal strength only when the tickler is connected in the correct direction. If increasing the coupling decreases the strength of the signals, the leads to the tickler should be reversed.

Lack of regeneration on either possible tickler connection generally indicates a partially short-circuited secondary, the lack of a bypass condenser in the regenerating plate circuit (across phones or primary of audio transformer), or a tickler coil of the wrong size, that is, too small or too large.

THE Pyratek fixed crystal detector clips nicely into the standard grid leak mountings. Only one mounting is furnished with each Pyratek detector, and the use of the grid leak holder facilitates experimentation with additional sets without the expense or necessity of extra cartridges.

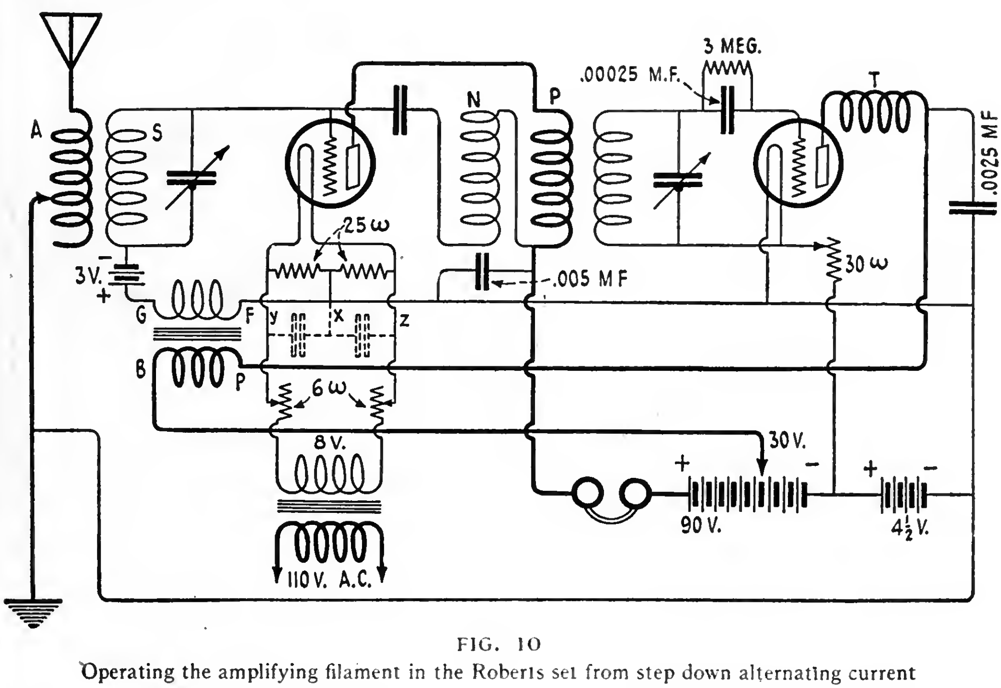
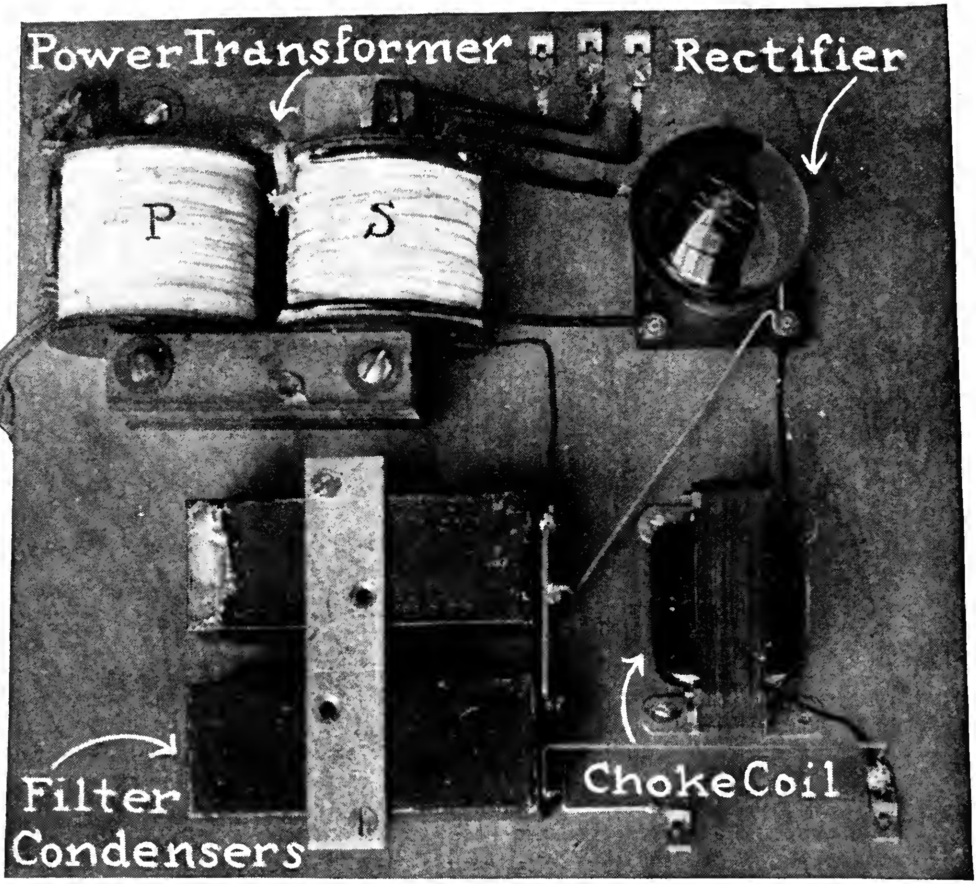


FIG. 10
Operating the amplifying filament in the Roberts set from step down alternating current



How to Make a Plate Supply Unit

A Very Simple and Inexpensive Device Furnishing Up to 200 Volts Without the "Hum"—The Parts Cost about $20 and are Readily Obtainable

By ROLAND F. BEERS

THE problem of supplying B battery potential for modern multi-tube radio receivers has rapidly become one of importance to every broadcast listener. When the plate current of present-day amplifying tubes attains a value of 12 milliamperes per tube (as in the W. E. 216-A), the current drain imposed by several of these tubes will shorten the life of dry cell B batteries to a few weeks. The cost of replacement alone soon becomes prohibitive.

It is the object of this article to describe in detail a device for supplying B battery voltage for any number of tubes and for any voltages that may be desired. The choice of voltages remains with the builder who can best determine his own requirements. The device is designed to operate from the 110 volt 60 cycle light socket and will deliver up to 100 milliamperes of plate current. In other words, this current supply set will supply plate current for 12 UV-201-A or 8 W. E. 216-A tubes, or

any number of tubes less than this. It will also supply any radio-frequency amplifier and a well-balanced two-stage audio-frequency amplifier with alternating current for heating the filaments. The set may be built by any one who will follow the plans carefully, and the total cost of parts, including the vacuum tube rectifier, should not exceed $20.00.

The general arrangement of the apparatus may be seen on page 268, which is a photograph of one of the sets constructed by the author on a circuit board. Fig. 1A shows the schematic diagram of the parts and the electrical connections. The parts include a power transformer which transforms the 110 volt alternating current from the ordinary light socket to 130 volts alternating current and to 6 volts alternating current for the filament supply of vacuum tubes. The 130 volt alternating current is then changed into a pulsating current which flows in one direction only, by means of the vacuum tube (VT), Fig. 1A. An efficient filter (indicated by dotted lines, and including the choke coil (L) and two filter condensers (C) smooths out the ripples in the unidirectional current, giving an unvarying source of direct current at 120 volts potential, which will operate the receiver in place of the usual batteries without hum. If a crystal detector is used, the entire current supply may be obtained from the light socket. If it is desired, a dry-cell detector may be employed in place of the crystal.

The arrangement illustrated in the photograph need not be followed exactly, but care must be taken in assembling the parts in order to insure short leads in wiring. The necessary parts and their approximate cost are listed below.

Simple, Cheap, and Efficient

In September, Radio Broadcast described the LeBel rectifying unit for supplying the plate voltage to radio receivers. The popularity and demand for such a device were manifested in the enormous amount of mail we received.

Mr. Roland Beers developed in his laboratory at Binghamton, New York, the very complete unit here described. Mr. Beers tells us there are seventeen of his units already in use in Binghamton. From our inspection and test of this apparatus we can unequivocally say that it will come up to the expectations of the most exacting of constructors.

Mr. LeBel's device was limited, in construction, to those versed in the art of electrical design or to those who were fortunate enough to order the necessary parts "before the rush."

With Mr. Beers's unit there are no possible restrictions or conditions. Most of the parts for this device may be obtained from the local electrical or hardware store. It is extraordinarily inexpensive to build.

—The Editor.

PRACTICAL AND SPECIFIC DESIGN

THE writer has thought it well to describe in detail a practical and specific design for a complete current supply set, and then to indicate such deviations from this design as may be made for the sake of utilizing whatever spare parts the constructor may have.

We will first consider the construction of the power transformer. Its purpose, as we have indicated before, is to change the 110 volt alternating current to such voltages as we need for our use. For this purpose, we have four separate windings, each easily made. These windings are placed on two of the legs or branches of the core, as illustrated in Fig. 1. The core of the transformer is built up of strips or laminations of silicon steel .014 inches thick. The material for these strips can be bought at electrical supply houses, or it may be obtained from an old pole transformer which can often be had for the asking at the

1 lb. No. 28 double cotton covered wire	$1.50
$\frac{1}{2}$ lb. No. 34 black enamel or double silk wire	.90
$\frac{1}{2}$ lb. No. 18 double cotton covered wire	.50
$\frac{1}{2}$ lb. No. 34 black enamel or double silk	.90
2–No. 21–D Western Electric 2 mfd. condensers or 4–No. 133 Federal 1 mfd. condensers at $1.00	4.00
4 lbs. .014 in. silicon steel for power transformer	1.00
3 lbs. .014 " " for choke coil	.75*
1–V. T. Socket	.50
1–VT–2 or 216–A or UV–201 or UV–201-A or UV-203	4.00
5–8 Fahnestock clips	.15
	$14.20

*May be omitted if the builder desires to buy his choke coil ready-made.

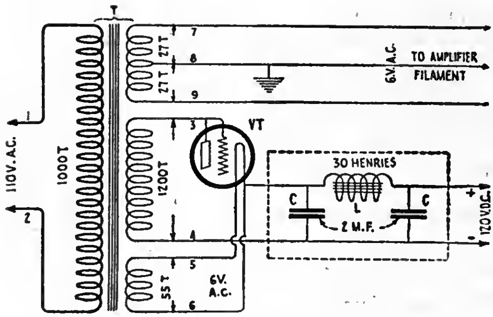


FIG. 1 A

A schematic diagram of the current supply set showing the values of the elements

electric light company's office. The thickness of the steel is not of great importance, although material of much greater thickness than that indicated will cause the transformer to run up the electric light bill rather fast.

Strips 1 inch x $3\frac{1}{2}$ inches are cut from the steel with a pair of tinner's shears to make a pile about 4 inches high when they are pressed together. This pile will require about 300 pieces, which can be assembled in the manner shown in Fig. 2. It may occur that the laminations procured from the old power transformer have dimensions very near to those given here, and in such a case, they may be used as they are. A variation of 10 per cent. plus or minus will not be of consequence. When the strips have been prepared, they are laid aside ready for use after the transformer windings have been completed.

The windings of the transformer consist of the following:

1. Primary—1000 turns No. 28 D. C. C. wire, placed on one leg of the core, as shown at P in photograph. This winding has two ends or terminals, numbered (1) and (2), as shown in Fig. 1A.
2. Secondary—1200 turns No. 34 black enamel or D. S. C. wire, placed next to the core on the opposite leg of the transformer, as shown at S in Fig. 1. Two terminals numbered (3) and (4), Fig. 1A.
3. Secondary—55 turns No. 18 D. C. C. wire, placed over winding No. 2. Two terminals, (5) and (6), Fig. 1A.
4. Secondary—27 turns No. 18 D. C. C. wire, placed over winding No. 3.

This winding is made of 27 turns of a twisted pair, which will be described below. There are three terminals, including the center tap, which are numbered (7), (8) and (9), Fig. 1A.

The writer constructed a spool to contain each set of windings, as shown in the photograph and in Fig. 4. While this construction is not absolutely necessary, it makes a neat job and facilitates the problem of high voltage insulation. Another method of constructing the windings will be given later, for the benefit of those who prefer to make form-wound coils.

MAKING THE TRANSFORMER

FOR the spools, two pieces of micarta or fiber tubing $1\frac{1}{2}$ inches inside diameter and $2\frac{7}{16}$ inches long were fitted with fiber ends $3\frac{1}{4}$ inches outside diameter. (These dimensions correspond to the core described above.) The ends were secured to the tubing with cement, and holes were drilled in them for the lead wires of the various windings, as shown in Fig. 4.

One spool contains the entire primary winding, No. 1. The wire may be wound on by hand, or the spool may be clamped in a drill chuck by means of a long bolt and two large washers. The handle of the drill chuck may be clamped in a vise and the winding is ready to start. If the ratio of turns of the drill chuck to the crank are known, it will reduce the labor of counting turns. Simply count the number of revolutions of the crank and mentally multiply by the ratio every time a multiple of ten is reached. Before actually starting the winding of the fine wire, solder a four foot length of flexible insulated wire to the end of the magnet wire and insulate it well with a short piece of cotton sleeving or spaghetti. Wind at least one full turn of the heavy wire around the spool, tie it in place with string, and proceed with the rest of the winding. It is not necessary to keep the wire in flat layers provided it is kept tight and free

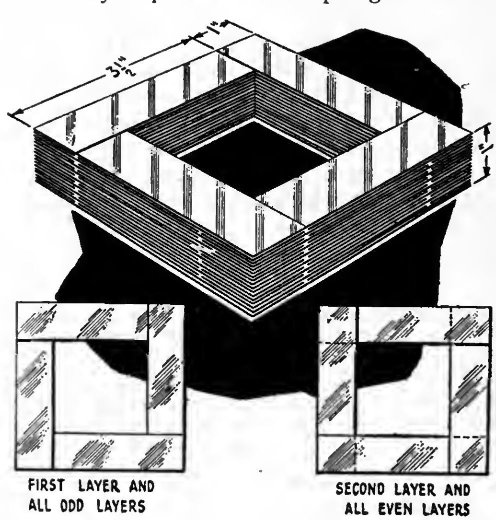


FIG. 2

Which shows the method of assembling the laminations in the core of the power transformer

from loops that are apt to protrude beyond the edge of the spool heads. If the winding gets rough or "bumpy," remove the rough part and wind it over again.

When the required number of turns has been placed on the spool, again solder a flexible lead wire to the end of the fine wire, insulate and tie it in place with string. Now carefully wrap six layers of muslin or three layers of Empire cloth over the winding, and cement the last layer in place with insulating cement. We are now ready to proceed with the second spool, which contains the three secondary windings.

OTHER WINDINGS OF THE TRANSFORMER

WINDING No. 2 is wound exactly as was No. 1, with regard to insulation of the leads. It must be wound in smooth layers, and extra care must be taken to keep layers from overlapping. It may be necessary for the constructor to place thin strips of paper between layers of wire as they are wound, but no more papers should be used than are absolutely necessary. When this winding is completed, six layers of muslin or three layers of Empire cloth are fastened in place over it, and the third winding is started.

The third winding should be wound in two smooth layers without papers between the layers. In case the second layer is not completely full, the remaining space may be used for the fourth winding, which is applied directly over winding No. 3. The leads of the third and fourth windings are brought out at the same side of the spool head, while those

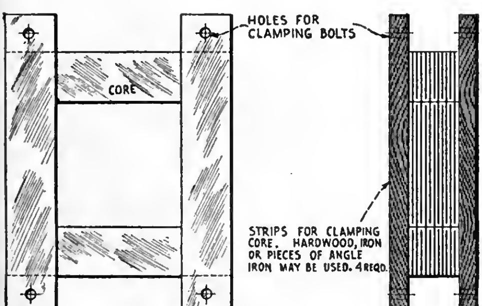


FIG. 3
Detail drawing showing how the clamping plates for the transformer or choke coil are made and attached

of the second winding are brought out at the opposite side of the spool head.

The fourth winding is made of a twisted pair of wires and is used to supply 6 volt alternating current to the filaments of the amplifier tubes. If more than one audio-frequency amplifier tube is supplied with alternating current for heating the filament, the hum will be noticeable, unless special precautions are taken to balance the amplifier

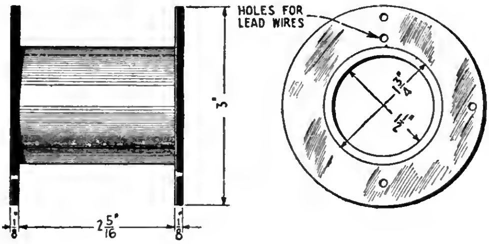


FIG. 4
Detail drawing of the spool for the transformer windings which may be of micarta or phenol fiber. Two are required

for inductance and capacity. Any inherent unbalance or tendency to "howl" will at once produce a loud hum in the loud speaker when all filaments are supplied with alternating current. For that reason, the experimenter should be thoroughly familiar with his audio amplifier before he attempts to supply the filaments with A. C. If this supply is not desired the fourth winding may be omitted. Should the constructor desire to use an Amrad s tube as the rectifier, the third winding will also be unnecessary.

To make the twisted pair, stretch out about $\frac{1}{4}$ lb. No. 18 D. C. C. wire in two strands of equal length. Fasten the looped end over a hook and secure the two loose ends in the chuck of a hand drill. Several turns of the drill will give a neat and uniform twist to the pair, which should be of the order of three twists per inch. The looped end of the twisted pair can now be cut, leaving two separate conductors which have uniform magnetic coupling with respect to each other. Let us call one wire of the pair, wire "A," whose initial and terminal ends are, respectively, (a) and (b). The second wire we shall consider to be wire "B," with corresponding terminals, (c) and (d). The ends, (a) and (c) will be at one end of the twisted pair, and ends (b) and (d) will be together at the other end. By connecting a dry cell and an electric buzzer or doorbell in series, leaving the remaining buzzer circuit open, we can soon determine which wire of the pair is "A" and which is "B." Simply connect terminal (a) to the battery and touch one or the other of the terminals (b) and (d) to the buzzer until the circuit is completed. When the buzzer

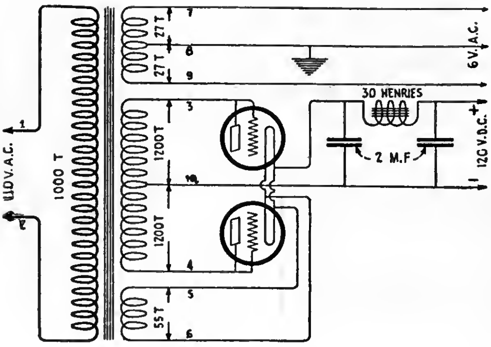


FIG. 5

A diagram showing the schematic layout of the circuit connected as a push pull amplifier using UV–199 tubes where heavy plate current is drawn

operates, the terminal which completed the circuit should be marked with a tag as terminal (b). The remaining terminals are, of course, (c) and (d).

After the twisted pair has been wound on the spool, terminals (b) and (c) are twisted totogether and soldered. A flexible lead is soldered to the joint, which is conducted to terminal No. 8, Fig. 1A. This point is the zero potential or ground point of the amplifier circuit. All grid return and plate return leads of the amplifier must be connected to this ground, which must also be connected to earth. Terminals (a) and (d) are connected to No. 7 and No. 9, respectively, Fig. 1A, as the 6 volt alternating current supply of the amplifier. The fourth winding is insulated with six layers of muslin or three layers of Empire cloth, as before, and the spools are ready for assembly on the core.

FINAL TRANSFORMER ASSEMBLY

AFTER the windings have been completed and properly numbered with tags, the steel strips may be inserted in the spools and the core clamped together. It will be best to alternate the position of the lapped corner, every time a new layer of laminations is applied, as shown in the small sketches of Fig. 2. When near the top of the pile, compress the core as much as possible, and squeeze in as many strips as can be forced into the spools. After all the laminations have been put in the core, it is ready for the clamping plates. These are made of strap iron or hard wood, as shown in Fig. 3. Four strips are cut to the size required by the core, leaving at least one-half inch at each end for clamping holes. Stove bolts are passed through these holes, which may be drilled with a $\frac{1}{4}$ inch drill, and the clamping plates are screwed down tightly when the core is completely assembled. It is important to clamp every lamination in place as tightly as possible in order to reduce the possibility of mechanical vibration. Such a vibration will often make a very unpleasant hum in the room where the set is being used and will confuse a discriminating observer so that he will believe the hum is produced in the loud speaker.

A physical conception of the action of the filter may be gained from the following explanation. The large capacity condensers (C) in the diagram of Fig. 1A afford a comparatively easy path for alternating current, which is what we are trying to eliminate by the use of our filter. With every change in direction of the alternating current, a certain amount of electricity is carried through the large condensers and back to the system. The choke coil, (L), permits direct current to flow through it with no opposition except the direct current resistance, but offers a large inertia or impedance to the ever-changing alternating current. On account of this opposition to the alternating current, it seeks an easier path through the condensers, and back to the line. The result of our filter action is that we have sifted out, so to speak, the undesirable alternating current, which produces the hum, and have left a pure, uniform direct current, exactly like that delivered by our dry cell B batteries.

The choke coil for the filter may be constructed as indicated below, or it may be purchased from a well-stocked electrical supply house. The value of its inductance should not be less than 30 henries. Values as high as 50 henries may be used with excellent results. The direct current resistance should not exceed 750 ohms, although a value greater than this will only serve to decrease the output voltage.

HOW TO BUILD YOUR OWN CHOKE COIL

THE following dimensions will serve those who wish to build their own choke coil. Strips of .014 $''$ silicon steel are cut $1'' \times 2\frac{1}{4}''$ to make a pile $4''$ high. This will require about 300 pieces. Four hardwood or strap iron strips $1'' \times 3\frac{3}{4}''$ are cut and drilled for the mounting holes, as was done in the case of the power transformer. Spools may be constructed for the windings, if desired, or they may be placed directly over the two opposite core legs, after they have been wound with three layers of Empire cloth. The spools may be made of micarta or card-

board tubing $1\frac{1}{2}''$ inside diameter and $1\frac{3}{16}''$ long. Spool heads are cut to fit the tubing $1\frac{5}{8}''$ outside diameter. The coil has two windings, each of 3500 turns of No. 34 black enamel or double silk covered wire, and each wound in the same direction. Flexible leads are provided for the terminals exactly as was done for the power transformer. The inner end of one winding is soldered to the outer end of the other winding, and the joint is insulated with cotton sleeving or "spaghetti." Six layers of muslin or three layers of Empire cloth are wound over the completed windings to protect them from damage. The core pieces are then inserted in the spools, but instead of lapping the corner joints, they are simply butted up against each other as neatly as possible. When the entire core has been assembled into a square form, the clamping plates are put in place and carefully tightened up.

Each of the condensers used in the filter circuit should be of at least 2 mfd. capacity. Larger condensers may be used with some improvement in the efficiency of the filter. It is not necessary to have two condensers of the same capacity, but each must be of at least 2 mfd. As high as 5 mfd. can be used with good results. The condensers should be tested for leaks before placing them in the circuit by charging them with a high voltage B battery and then discharging them after 15 minutes. If they are in good condition, a fat spark will jump when they are discharged. If no spark jumps, they are defective, and will short-circuit the B voltage.

The rectifier tube used most commonly by the writer is the Western Electric E tube or VT-2. This tube is probably as well suited for the purpose as any tube except the special rectifier tubes, such as the G. E. kenotron-UV-216 or the S tube, each of which costs more than a VT-2. Other tubes that have been used with good results are the W. E. 216-A, the UV-202, UV-201, and the UV-201-A. Such changes as are necessitated by the use of a tube other than the VT-2 are indicated below.

MOUNTING

THE apparatus illustrated in the photograph was mounted on a circuit board 12″ x 12″. Fahnestock clips may be used for terminals, or if it is desired, the conventional type of binding post may be adopted. All wiring should be as short and as direct as possible, and all joints should be soldered butt joints. Wires which carry 60 cycle current may be reduced to their absolute minimum length with considerable improvement in the performance of the set. If difficulty is experienced in reducing 60 cycle hum in the receiver, it may be reduced by wiring all 60 cycle leads with lead covered cable.

The writer has constructed several current supply sets in the usual manner and has had difficulty in obtaining satisfactory operation of them on particular installations, even though they gave perfect satisfaction on his own receiver (super-heterodyne). The difficulty usually lay in one or more places which became conspicuous after several preliminary tests. If the current supply set causes a terrific hum in the loud speaker when it is connected to the radio receiver, several possible errors may exist. We shall assume that the set is wired up correctly and that there are

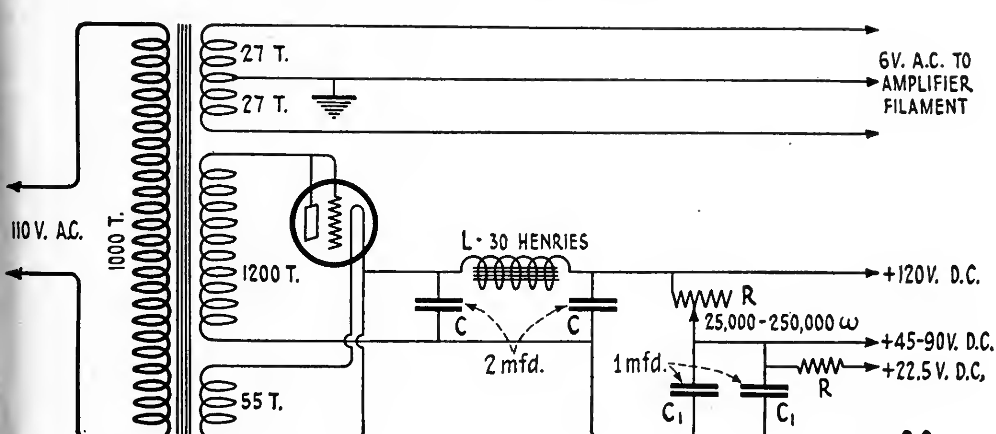


FIG. 6

How variable and multiple voltages may be obtained with the current supply set. The values of the parts are indicated

no open circuits. First of all, it will be necessary to choose both rectifier and amplifier tubes with care. In the writer's experience, bootleg tubes are the most frequent cause of trouble. Some VT-2 tubes will give excellent performance, while others simply will not function. The same applies to the UV type tubes, and in general, relief from the disturbance may be had by testing and finally selecting tubes that will reduce the hum.

Another source of trouble is often found in excessive amplifier or rectifier filament voltage. The number of turns given in the constructional data was correct for a large number of the tubes used by the writer, but frequently it was necessary to add or remove turns from the third or fourth windings in order to obtain good results. A rheostat should *not* be used to regulate these voltages, unless it is a primary rheostat, placed in series with winding No. 1. The proper method of obtaining the correct filament voltage is to alter the number of turns on the respective windings, adding or removing turns one by one until the correct value is found. This change should be made while the set is supplying current to the receiver, if possible, in order to duplicate actual conditions.

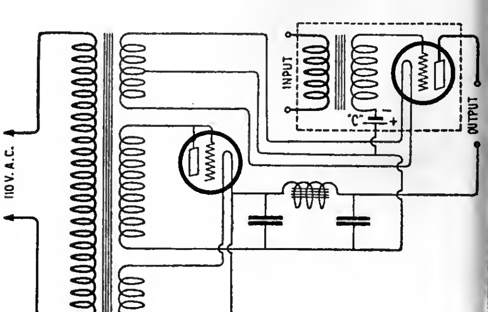
AVOIDING THE HUM

ANOTHER source of hum is frequently found in excessive plate voltage. This trouble may be remedied by the insertion of a lavite or other current-carrying resistance in the plate supply. The writer has used Western Electric No. 38 type and the Bradleyohm with good results. Ward-Leonard resistances are also known to have given good results. The value of the resistance can best be determined by trial with the tubes which are receiving the excessive plate voltage. Another method of reducing the plate voltage is, of course, to remove turns from the high voltage or second winding, until the proper voltage is obtained. Still, another method of reducing the hum caused by excessive plate voltage, and perhaps the most satisfactory one, is to increase the negative C voltage until quiet operation prevails. The writer has used as high as 20 volts negative C battery on a Western Electric tube with 150 volts on the plate. Other tubes will require correspondingly more or less C voltage. It is sufficient to say that under ordinary circumstances it will be very difficult to obtain quiet operation of a radio receiver supplied with alternating current filament supply unless a fairly high C battery is employed.

A fourth source of disturbance is often found in the stray flux or leakage of alternating current magnetism from the cores and wires of the current supply set. An amplifier that has some inherent unbalance or tendency to "howl" will invariably exhibit a loud hum when supplied with alternating current, although it may appear perfectly stable when supplied with direct current. The remedy in such a case is to place the entire current supply set in a tin or iron shield, and to connect the shield to earth. Fig. 7 shows a view of a current supply set connected to a two-stage amplifier, where it was necessary to shield the entire supply set. Here all leads were shielded with lead covered sheath, and the entire shielding system was grounded. Any iron box may be used to contain the set, such as an old panel switch box, biscuit tin or other tin container. Holes may be cut in the box to accommodate the socket and leads, and these should be very well insulated to prevent arcing of the high voltage.

SUGGESTED POSSIBLE ALTERATIONS

IT MAY be that the constructor already has laminations or a core from an old power transformer that he would like to use. In such a case the following remarks will be helpful. The primary requirement is that the inductance of the primary winding shall be not less than one henry. This means that for a 1000 turn winding the ratio of cross-sectional area to length of magnetic circuit $(\frac{A}{e})$ should be not less than 0.6 centimeters, and for normal saturation of the core the cross-sectional area should be not less than 2.5 sq. cms. Values in excess of these will result in good performance. If the values of A and $\frac{A}{e}$ vary greatly from those given above, a new value for the number of turns must be found to give the proper value for the primary



A SCHEMATIC DRAWING

Which shows the connections for the unit when a power amplifier circuit filament is supplied with alternating current

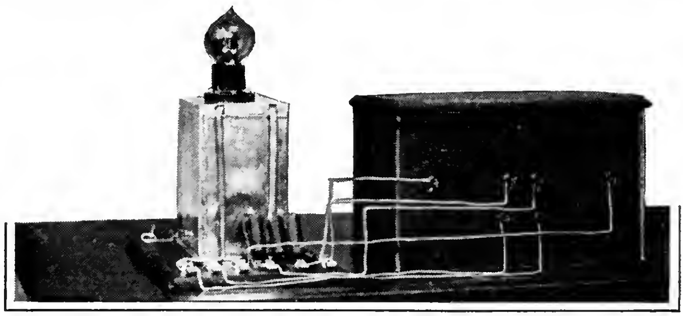


FIG. 7
Another set-up of the current supply set

inductance. It will probably be better in such a case to remodel the core to the dimensions given by the writer. Such a problem is best left to the judgment of the constructor.

There are obtainable on the market certain choke coils that could be used in the filter circuit. The Acme Apparatus Company sells a good C. W. choke that gives excellent results in the filter circuits of amateur transmitters. Such a choke will give good performance in the current supply set, but is probably more costly than the builder would wish. A more reasonable choke coil has been recommended by G. M. Best in the June, 1924, Radio. That coil is the General Electric Wayne No. 179,541 Bell Ringing transformer, whose primary winding is said to have a high inductance. The writer strongly recommends building one's own choke coil, in order to obtain sufficient inductance. The coil described above will have an inductance somewhat in excess of 30 henries, depending upon the care with which the core is assembled.

A WINDING FORM

IF THE experimenter does not want to make spools for the windings, he may make a winding form as follows:

Cut a square block of soft wood the same cross-section as the core leg which is to contain the windings. Save room on each end in which to drive a spike for holding the form and clamping it in the winding rig. Then wrap the wooden form with two layers of heavy string in smooth layers which will extend $\frac{1}{2}''$ beyond the ends of the winding. Over the string wrap two layers of Empire cloth and cement the end in place. Begin the winding with flexible stranded wire (insulated) and continue this heavy wire for one quarter turn. Proceed with the winding of the smaller wire, placing thin papers over each layer until it is completed, and allowing each paper to extend $\frac{1}{8}''$ beyond the edge of the winding. Continue to build up the coil in this manner until the last layer is completed. The outside lead wire should occupy at least one quarter of the last layer of winding and the end should be firmly tied in place with string. Wrap over this layer three layers of Empire cloth and cement the end fast.

The two layers of string underneath the winding may now be carefully unwound, and the coil carefully slipped from the form. *Very carefully* wrap one layer of friction tape around the outside and inside of the entire coil, carrying the end of the tape through the center of the winding each time until the entire coil is made into a firm and substantial structure. The completed coils may be slipped over the legs of the core and the laminations will hold it in place. In this method of winding, it will be necessary to assemble three legs of the core first, leaving the fourth leg open to permit putting the windings in place. The remaining strips may be assembled and the core may be bolted together.

If UV-201 or UV-201-A tubes are used in the rectifier or amplifier circuits, windings No. 3 and No. 4 should consist of 48 and 24 turns, respectively. If 50 milliamperes or more are to be drawn from the set, using UV-201-A or UV-201 tubes, their life will be considerably shortened. It will then be necessary to use two such tubes in parallel, or the full-wave rectification, push-pull circuit may be adopted, as shown in Fig. 5, and the high voltage winding No. 2 must contain twice the number of turns previously specified. Each high voltage winding is wound in exactly the same manner as before, except that each winding occupies but half the spool on which the windings are placed. They are best wound by placing a divider in the middle of the spool, which is the same size and material as the spool heads. Each section of the divided spool will be of the same size and will contain the same number of turns, i. e., 1200. The two windings are wound in opposite directions to each other, bringing the outer end of each winding to the center of the spool, near the divider, when completing the last layer of each winding. The two adjacent ends, each an outer end of its respective winding, are then connected together and soldered, and this point is the

negative terminal of the plate supply system, as shown at (10) in Fig. 5. It is the electrical mid-tap of the secondary winding, provided care has been taken in placing the same number of turns on each half of the spool.

For UV-202 rectifier tubes, winding No. 3 must consist of 68 turns, instead of the number previously specified.

SUBSTITUTING FOR THE ELECTRON TUBE

IF THE builder wishes to use an S tube in place of the electron tube, the third winding may be omitted. It will be necessary to increase the number of turns of the second winding to 4500, and special precaution must be taken to prevent voltage rupture of the coil. In this event, a larger winding spool must be used, and the size of this can be determined by trial after the core has been cut out. Spool heads 3½" outside diameter will accommodate the increased number of turns, and the winding should be broken up into at least four sections, each separated from the others by a micarta separator, of the same size and shape as the spool heads. With this change, the builder can adapt the S tube to his use. Considerable resistance will necessarily be inserted in the plate supply, which may be determined by trial. Probably a minimum of 20,000 ohms will be required, as suggested by C. J. LeBel in the September RADIO BROADCAST.

THE SET DELIVERS 120 VOLTS

THE writer has indicated a secondary winding No. 2 to give 120 volts direct current, but this value may be altered to suit the builder's particular needs. The set illustrated in the photograph actually delivers 200 volts, which are applied to the plate of a power amplifier tube. Western Electric lavite resistances are inserted in series with the positive plate lead to give lower voltage values. The set illustrated in Fig. 7 delivered 120 volts, 90 volts, 45 volts or 22.5 volts, as might be required.

Multiple voltage may be obtained by the use of the proper resistance inserted in the plate lead. The method indicated on page 371 of the September RADIO BROADCAST by C. J. LeBel will be found to be satisfactory and still another method is shown in Fig. 6, and illustrated in Fig. 7. In this method, high resistances are placed in series with the positive B battery voltage, causing a drop of the desired amount. Fig. 7 show three Western Electric No. 38-B lavite resistances connected in series, with taps taken off at the desired points. The writer has also used the Bradleyohm with good results. The variable control of the Bradleyohm will be found useful in varying the detector plate voltage on soft tubes. Any number of resistances can be connected in series, taking taps off wherever desired, so that the proper voltages can be obtained. If any difficulty is experienced in eliminating hum when multiple voltages are employed, it may be eliminated by the use of proper by-pass condensers of 1 mfd. or 2 mfd. capacity shunted around the various taps. This is illustrated in Fig. 6, at C', where a 1 mfd. condenser is shown connected across the 45 volt tap.

FOR OTHER SUPPLY FREQUENCIES

IN THIS article, all construction details apply only where the usual 60 cycle A. C. supply is available. The unit described will not function properly in its present form when used on any other frequency. However, the author, in anticipating the demand for details from those fans whose supply is 25 cycle A. C., gives the following constructional changes. The first consideration is that the cross-sectional area of the cores for the transformer and for the choke coil will have to be doubled, while the lengths would remain the same. The detailed changes, including spool dimensions, are as follows:-

Transformer core—600 laminations 1" x 3½" outside measurements 4½" x 4½" x 2" high cross-section 1" x 2" high.

Spool made of fiber or red rope paper built up of several layers and cemented together with Ambroid cement—inside measurements $1\frac{1}{16}$" x $2\frac{1}{16}$" x $2\frac{7}{16}$" long.

Rectangular spool heads 3¼" x 4¼" with window to accommodate rectangular spool.

Choke coil core—600 pieces or laminations 1" x 2¼"
outside measurements 3¼" x 3¼" x 2" high cross-section 1" x 2" high.

Spool made up as above—inside measurements $1\frac{1}{16}$" x $2\frac{1}{16}$" x $1\frac{3}{16}$" long.

Rectangular spool heads $1\frac{5}{8}$" x $2\frac{5}{8}$" with window to accommodate spool.

The turns of wire must remain the same as specified in the article, but it will take about thirty per cent. more wire for the windings in each case.

Where a 40 cycle supply is the only available one, it is necessary to increase the cross-sectional area of the cores one-third. Details of core and spool construction would be varied accordingly. —THE EDITOR.

THE FIRST RADIO WORLD'S FAIR

At Madison Square Garden, New York. A large overflow display filled the 69th Regiment Armory across the street. A wealth of new radio apparatus was shown here, including new loud speakers, great numbers of sets with radio-frequency amplification, and reflexing.

A Few Ideas and Ideals

Being a Brief Outline of Our Policies Regarding Some Subjects Heretofore Discussed in Whisper or Behind Closed Doors

By ARTHUR H. LYNCH

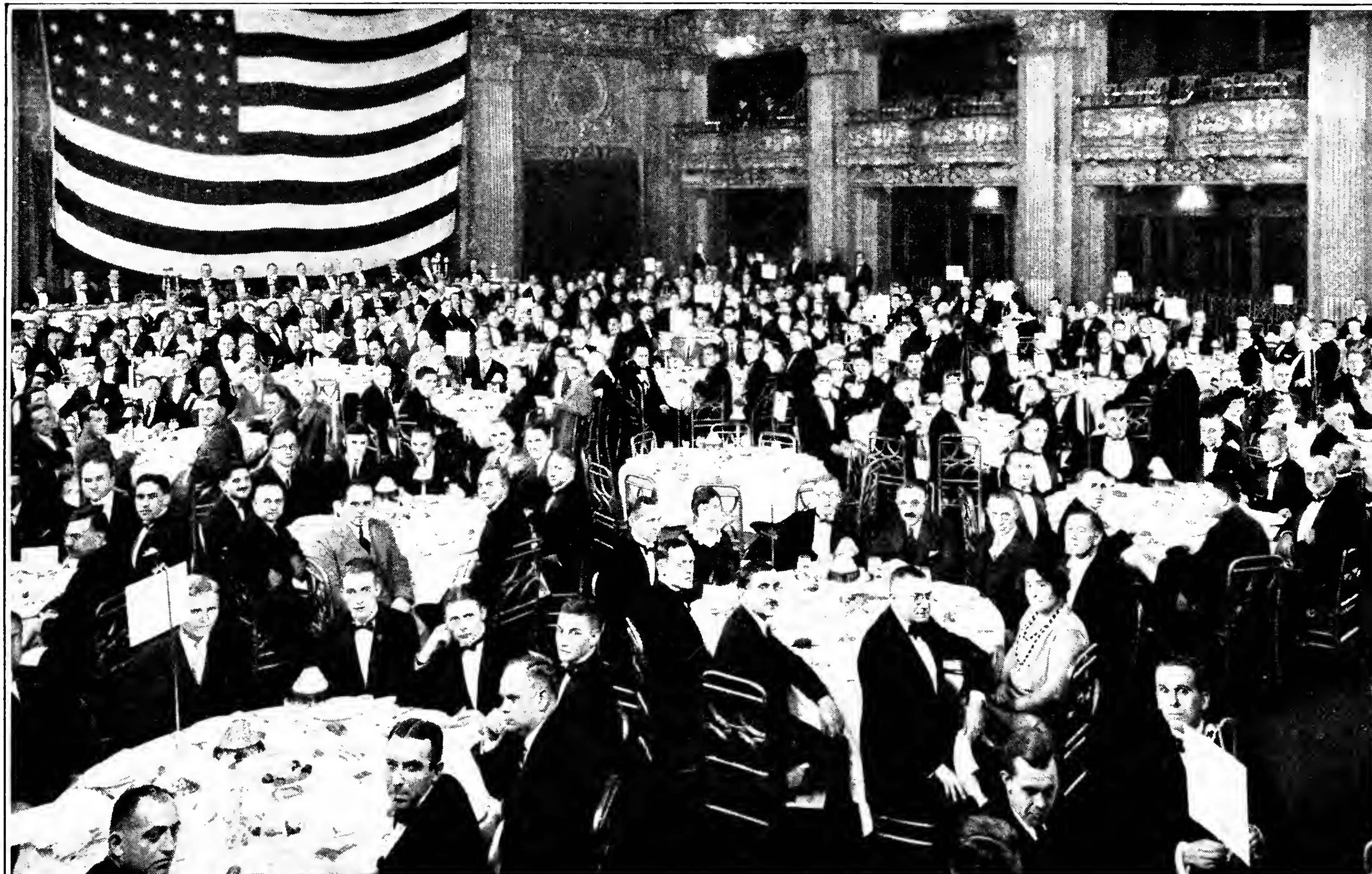
NOT once, but many, many times, have we been asked: "If these receivers that you tell how to make really do the wonderful things you claim for them, how the mischief do you square yourselves with the manufacturers of ready-made receivers who advertise with you?

At first thought that would be a rather difficult question but upon a little serious consideration it isn't. Let us get right at the facts as they are.

There are, at present, more radio publications than at any previous time in the history of the art. In the aggregate, more space is devoted to so-called "how-to-make-it" articles for public consumption than ever before. The proportion of space devoted to such articles as compared to general articles is increasing in most publications.

Many publications have realized the folly of giving space to the description of questionable receiver designs and, for the most part, the man-in-the-street can really build a good receiver from the design he finds in present day publications.

More people are building receivers at home than at any other time in radio's history. Schools are teaching students how to build radio receivers. Boy Scout Camps are doing likewise. The dealers all over the country are doing a tremendous business in parts. And, in the face of all the above *there are*



THE BANQUET OF RADIO DEALERS, MANUFACTURERS, AND JOBBERS AT THE HOTEL WALDORF, NEW YORK

more complete receivers being sold than ever before.

Such a *resumé* might lead to no conclusion, if it were not for the fact that the popularity of radio reception is based almost entirely upon publicity. Judging from the foregoing, the increased sale of complete receivers might be considered as nothing more than a result of the very rapid growth of the entire business were it not for the additional fact—at least most of those in a position to judge believe it a fact—that the proportion of home-made to ready-made receivers is gradually decreasing.

HOME AND FACTORY BUILT SETS

AND, having considered these facts, let us proceed with the explanation of our stand in the matter. Our first argument is that the more home-built receivers there are, the greater will be the demand for those of factory make. Every person who builds a radio receiver that works well is enthusiastic. A thousand people in a small town may see and hear Bill Jones' one-tube bringing in concerts from stations all over the country. They're impressed and many of them will want a receiver of their own. Many of them wouldn't be satisfied with one like Bill Jones'. If he can build one for a few dollars and it works so well, why just imagine what a real set would do, is the way many of them reason. Others wouldn't be bothered making a receiver even if they had the time or were as smart as they figure Bill must be. Still others would like Bill to make a similar receiver for them, but most Bills are too busy with other things to warrant such work. Many manufacturers, who spend thousands of dollars a year advertising their products owe a great deal of their success to the start they got from a how-to-make-it article in some magazine.

Our readers have learned that when we say a receiver is capable of specified performance, our statements are usually very modest. They have learned that we describe only such receivers as we really believe to be good and that we don't care a hoot who manufactures the parts. We believe that the publication of good how-to-make-it articles is of direct benefit to the manufacturer of complete receivers.

THE HOW AND WHY OF THE KNOCK-OUT SERIES

EVER since RADIO BROADCAST came into being, a little more than two and a half years ago, it has waged a relentless war against radiating receivers because its editors as well as it publishers were convinced that the sale of high-grade receivers would ultimately suffer if "birdies", the pipings from such receivers, were allowed to fill the air. There was, we felt sure, plenty of natural interference, without adding more to it with the sale of every receiver.

For many months we searched for a receiver or group of receivers that would perform as well as those against which we were preaching, but the task was a great one. We tried all kinds of circuits, all kinds of tubes, everything we could lay hands on, but found nothing which would compare, let alone prove any better than the squealers, until, in the laboratory of a small radio company in New York we came upon the single-tube reflex receiver which has since become famous as our one-tube Knock-Out Receiver. It has been performing for more than a year now and hardly a mail comes in that fails to carry some commendatory expression upon the results being obtained by some reader who has built it.

You may be interested in a little story about this receiver. We saw it perform in the laboratory in New York but did not believe it would do as well in Garden City. We made a bet with John Meagher, who built the original model, that he could not make it operate a loud speaker at our plant. The bet was a hat. He brought the receiver out and lost. However, there is a great deal of electrical interference in our plant and we compromised by giving him an opportunity to demonstrate the receiver in our home, increasing the bet to two hats. He came; he did it; we lost two hats.

We would have been satisfied to hear the locals on the loud speaker. You may well imagine our surprise when we were able to hear three stations in Chicago, four in Philadelphia, and two in Cleveland with a single 199 tube on the speaker—not loud enough to dance to, it's true, but with enough volume to be understood thirty feet from the speaker when there was quiet.

Using this circuit, which, by the way, was not new—merely a very clever adaptation of an old idea—we have gone ahead with the development of the Knock-Out receiver idea. There are now one, two, three, and four-tube receivers, which we believe—and no one has ever shown any desire to compete with us—tube for tube and dollar for dollar, better than any receiver described for home construction in any publication up to the time they appeared.

CAN YOU HELP?

WE HAVE spent months improving these receivers; we're working hard on a new one now. Perhaps you can help to solve the problem. We want a three- and a four-tube receiver employing the Roberts circuit with a stage of transformer-coupled audio amplification and one with a stage of push-pull, made with regular cylindrical coils in place of the spiderwebs we are now using. This is due to the fact that our two, three, and four-tube receivers, employing the Roberts circuit are increasing in number so rapidly, that it is difficult to procure the spiderweb units.

This problem is not so easy as it may appear. Substituting the antenna coupling arrangement usually found in a neutrodyne and a rewound vario-coupler, would, it would seem, turn the trick. In fact they do work out quite well, when used in the two-tube circuit, or when resistance-coupled amplification is employed, but with the use of a stage of transformer-coupled audio, there is very noticeable distortion.

Several receivers have been sent us by manufacturers who thought they had solved the problem. They had, to a degree. We have hooked up several such receivers and they worked perfectly. Then we've changed the tubes or made some other changes which would be done in practice. Then the circuit wouldn't work.

But that's more or less in the future. Let's see what the Knock-Outs have done in the past. Briefly we may list their work as follows: They have

Given more satisfaction per tube than any other receivers for home construction.

Overcome the tendency toward the building of radiating receivers by performing better.

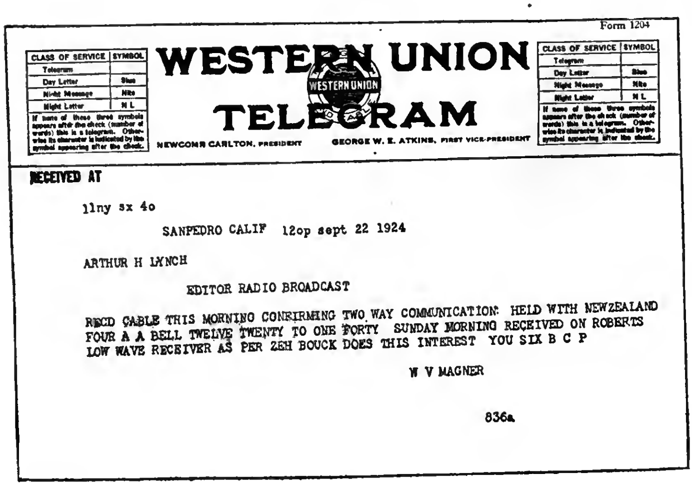
Improved the quality of receiver designs offered to the public by setting so high a standard that "trick circuits" could not keep pace.

Stimulated the sale of reliable parts.

Reduced the selling arguments necessary because their performance is internationally recognized.

Because of their excellent tone quality and ease of adjustment, brought radio to the attention of prospective buyers in an entirely new and better light.

Offered the manufacturer, dealer and jobber, a most sound method of sales promotion for the standard parts he has in stock, without favoring any one assisting the entire industry.



Form 1204

WESTERN UNION TELEGRAM

NEWCOMB CARLTON, PRESIDENT — GEORGE W. E. ATKINS, FIRST VICE-PRESIDENT

CLASS OF SERVICE	SYMBOL
Telegram	
Day Letter	Blue
Night Message	Nite
Night Letter	N L

If none of these three symbols appears after the check (number of words) this is a telegram. Otherwise its character is indicated by the symbol appearing after the check.

RECEIVED AT

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SANPEDRO CALIF 12op sept 22 1924

ARTHUR H LYNCH

EDITOR RADIO BROADCAST

RECD CABLE THIS MORNING CONFIRMING TWO WAY COMMUNICATION HELD WITH NEWZEALAND FOUR A A BELL TWELVE TWENTY TO ONE FORTY SUNDAY MORNING RECEIVED ON ROBERTS LOW WAVE RECEIVER AS PER ZEH BOUCK DOES THIS INTEREST YOU SIX B C P

W V MAGNER

836a

COÖPERATIVE COMPETITION

ONE of the outstanding features of the First Radio World's Fair recently held in Madison Square Garden and the 69th Regiment Armory in New York City was the love feast of competitors—a banquet held in the Grand Ball Room of the Waldorf-Astoria Hotel and attended by several hundred manufacturers, jobbers, and dealers. It was a fitting tribute to the advance made during the past few years in the industry at large.

Here, under the same roof—in many instances, at the same table—aye, even at the speakers' table—were the representatives of organizations which have law suits pending between them. When such organizations can, even for a single night, forget their controversies, meet on friendly ground and break bread together, we feel sure that much good may be accomplished.

Nor was the banquet the sole indication of the desire to get together. There were meetings of various trade, publicity, manufacturing, broadcasting and press associations which were conducted on a much more friendly basis than we have ever seen before. With everyone trying to coöperate we feel that the possibility of a huge business this winter is increased immeasurably.

REQUIESCAT IN PACE!

TO US, who have labored long in the preaching of the golden rule in radio receiving, no other one thing could be quite as satisfying as witnessing the almost entire absence of squealing receivers at the Radio Fair. At last, the gospel seems to have hit home and many erstwhile sinners have gone and got religion.

All manner of tuned radio-

Shake Hands With the "R. I."

The Problems, Pleasures, Tribulations, and Experiences of the Department of Commerce Radio Inspector—What Happened During the Years of Radio Growing Pains

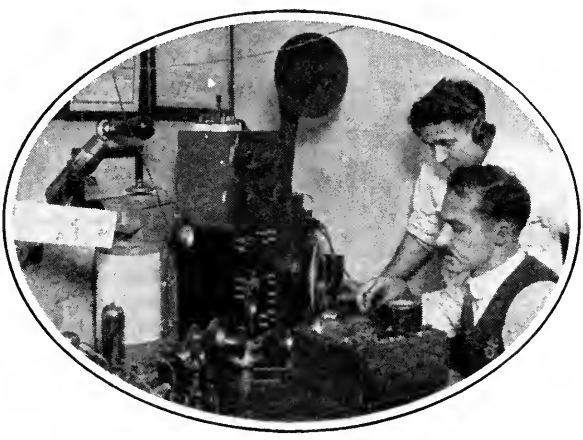
By HOWARD S. PYLE

Dear Sir:

I still can obtain no satisfaction from your office in clearing up the radio situation in Podunk. The amateur nuisance is unbearable, and we demand some relief. We urge you to send a man immediately to investigate. You say it is 'ships.' This is preposterous, as reference to your map will show our city to be located twenty miles from the ocean—there are no ships in Podunk.

Yours truly,
George Smith.

A PLEASANT start for a rather doubtful day, is it not? Yet this is what the heavy-eyed Radio Supervisor of your district is confronted with as he wearily takes his place at his desk to commence the daily grind. He comes to his office, not refreshed by a restful night's sleep, but dog-tired from a four or five hour vigil the night before, checking the frequencies of the various stations within range of his sensitive receiver. Not once in a while but *every* night, does he do this; not occasionally does he receive an irritating communication such as opens this article, but he gets numbers of them *daily*. And you, in the comfort of your fireside, complain bitterly at a few annoying splashes of static or an occasional ship transmittal which interferes with your pleasure. Maybe you write your district Supervisor, demanding some immediate action, and then grumble at the inefficiency of Governmental services if an inspector does not appear at your home the following evening ready to devote his entire evening to your interests. Suppose you pick a comfortable chair, get a fresh cigar and read on—meet your District Supervisor and his radio inspectors. An insight into the workings of the Radio Inspection Service of the United States Department of Commerce will give you a new respect for the men who are laboring many hours a day that your evening's pleasure may be uninterrupted.



THE RADIO INSPECTOR AT WORK

Emery H. Lee, one of the radio inspectors attached to the New York office is checking up the wavelength of an amateur operator's station, using a standard Department of Commerce wavemeter. The station license is on the wall and the operator's license in the frame to its left, both issued by the Department of Commerce, is next to it. The revealing sign and crêpe on the burned-out transmitting tube tell their own story of the price the amateur pays for his hobby

In 1912, radio communication was limited to communication to and from vessels on the Great Lakes and on the high seas, and between a few points on land. A number of companies controlled this service. When the rapid increase in radio stations came, petty controversies often came up between operators, and in numerous cases these original small arguments grew into serious affairs. A ship of one company, for example, refused to handle business with a ship or shore station of a rival organization. Worse, efforts were often made so to interfere with a competitor's operations to prevent his handling legitimate traffic.

Foreign vessels as well as those of

United States registry were then fast adopting radio telegraphy. No provision for intercommunication with vessels of different nationality existed. Briefly, radio communication up to 1912 was entirely unorganized. The problems presented by the increase in stations and the attitude of competing interests grew so menacing, that the Government found it imperative to interfere in order to protect its military signalling, and to gain some control over commercial traffic. Accordingly, an "Act to Regulate Radio Communication" was introduced and in due course of time became a law, in 1912. Among the various important provisions in this act was an article requiring all stations to intercommunicate regardless of the radio system employed. It was further provided that every radio transmitting station must be licensed by the Secretary of Commerce, and be operated only by operators examined and licensed by him. Certain technical limitations were placed on such stations, and in order that the law might be enforced, it was necessary to create a force of inspectors who would personally inspect each such station. It was found desirable to have these inspectors conduct examinations to determine the qualifications of an applicant for a radio operator license. Nine radio districts were established, with headquarters in the important industrial center nearest the central part of the district.

WHERE THE INSPECTORS ARE

THESE nine districts, with some slight changes of headquarters as demanded by varying conditions, are the same to-day. The present headquarters offices are located in New York City, Boston, Baltimore, Atlanta, New Orleans, San Francisco, Seattle, Chicago, and Detroit. A radio inspector, who was required to be a highly skilled technician, was assigned to each office, and in a few instances, assistants were also provided where the duties were extremely heavy, such as at New York. A Chief Radio Inspector, with offices in Washington, presided over the nine districts, and still does. He acts under the direction of the Secretary of Commerce, through the Commissioner of Navigation.

At the time of the formation of this branch of the Government service, a radio inspector's duties were to inspect each radio transmitting station in his district periodically; hold frequent radio operator license examinations and conduct periodic examinations in the larger cities throughout the district. In 1912 but comparatively few shore stations existed, and not many vessels carried radio apparatus. Since he had a consequently small number of embryo operators to examine, a radio inspectors' duties were not arduous.

Radio has grown steadily since the formation of this service. Just prior to the war, practically every vessel of any size at all carried apparatus. There were numerous shore stations in each district. Thousands of amateur stations existed throughout the country. Many private concerns owned radio stations for communicating only between their various plants and offices. All these stations were required by law to be inspected and licensed, and these tasks fell to the radio inspectors. An increase in the personnel was sadly needed but not forthcoming from Congress. The Department of Commerce Radio Service was forced to struggle along as best it might with the limited funds and personnel at its disposal, while radio was growing in importance and popularity daily. All this was before the inception of radio broadcasting.

AND THEN CAME BROADCASTING

SHORTLY following the new start of commercial radio telegraphy in the United States at the close of the war, the results of experiments made with radio telephone systems for military signalling became public property. It was not long before a few radio broadcast stations appeared. The public were inclined to be a bit dubious at first, but almost overnight, the flame of popularity swept the country and the demand for radio apparatus and broadcasting service was phenomenal. Stations for transmitting entertainment, education, news, etc., sprang up all over the country, and for each such transmitting station, thousands of receiving sets were installed. Under the law of 1912, all transmitting stations must be inspected and licensed. Each must be operated by properly licensed operators. These additional duties were added to the radio inspectors' already heavy burden. No provision was made in the 1912 law to cover radio telephone stations. The Radio Inspection Service had to draft suitable regulations to cover the new situation. A few additional inspectors were obtained through an emergency measure.

No sooner were the enormous problems which the broadcast situation had presented untangled to some degree, than a new menace made itself known in the flood of letters that began to pour into the district inspection offices. The public was becoming educated

in the new science, and had discovered with some surprise and much indignation that there were other signals in the air than those emanating from broadcast stations.

THE PUBLIC DISCOVERS INTERFERENCE

THE new listeners frequently had to contend with the code signals from near-by amateur stations, from ships and shore stations, and from high power transoceanic stations. An amateur radio station owner, was a personality—someone who could be readily visualized, whereas to a large number, the vessels, high power stations and the like were but a dim mental picture. The tide of public opinion turned against the amateur, for it was assumed that all interference from code transmissions must come from him. There were about twenty thousand transmitting amateurs in the country, nearly three thousand radio equipped vessels, and about fifteen hundred commercial shore stations scattered between the coasts. Those with broadcast receivers got a lot of interference. Broadcasting had been assigned wavelengths of 360 and 400 meters. With amateurs on 200 meters, and ships on 300, 450, and 600 meters, and taking into consideration the huge number of non-selective radio receivers (those subject to maximum interference) which were unloaded on an unsuspecting public, it naturally followed that the reception of the radio programs was not all that could be desired. The public was indignant. They did not propose to have their outlay rendered useless if it could be prevented. Accordingly, letters of protest were the first step. The problem of where to direct them was soon solved. Then, such a bulk of mail entered the radio inspectors' offices that it appeared next to impossible even to begin to handle it. But the radio inspectors rolled up their sleeves and "dug into it." It was soon found that by far the majority of letters dealt with interference, real or fancied, from amateur transmitters. This called for individual investigations which entailed an unbelievable amount of work. Due to the insufficient travel appropriation provided, it was necessary to permit such complaints to pile up until those from some certain territory became exceedingly insistent and numerous, and then the radio inspector would proceed to that community, and by working all day and far into the night for several days, would get the tangle somewhat straightened out. Meanwhile, complaints from some other section would pile up and on his return there would be a goodly number of investigations to conduct in other sections. Between trips, and while actually traveling, it was also necessary that he inspect ship and land stations and hold radio operator examinations.

When "Something Ought to be Done About Something"

Radio folk have gotten into the habit of writing to the Radio Supervisor in their district. The broadcast listener may have trouble with an interfering power line near by, or perhaps it is a neighboring code amateur whom they suspect of high radio crimes and misdemeanors. Forthwith, he writes to the Radio Supervisor. If ships pound in over the loud speaker, or if static is excessive, the inspector hears of it. Many there are who have dealings with the inspector, and this article may help to make that person a bit more of an entity. Mr. Pyle has been an inspector himself. He was attached to the Eighth District Headquarters at Detroit for some time. The entire radio staff of the Department of Commerce is rendering yeoman service to the country, and the magnitude of the task they are trying to accomplish with a pitifully small staff is not generally appreciated. The Department needs adequate running and administration appropriations, sufficient to care for the enormous expansion of its tasks. These, Congress has steadily refused.—THE EDITOR.

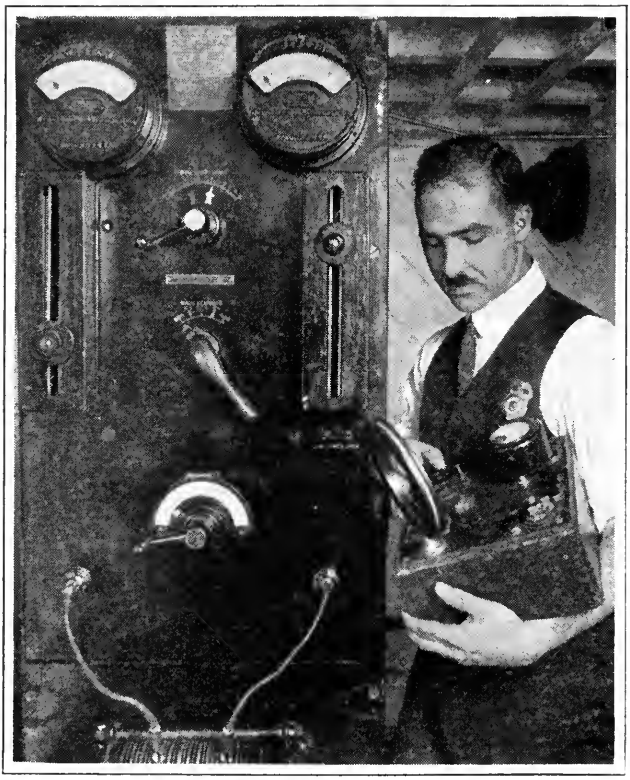
THE AMATEURS' TROUBLES

THE amateur problem finally became so acute, that the amateurs themselves felt they were in danger of extinction, so strong was the flood of public opinion against them. In spite of their splendid war services and other contributions to the art, such powerful influences were brought to bear as to make their position extremely precarious. They accordingly, voluntarily established a "silent period" from seven to ten-thirty P.M. daily, when they would shut down their transmitters to enable the new listeners to receive the broadcast entertainment without interference. This in a way, was successful, but the interference from the few who would not fall in line with their more far-sighted brothers, and from other sources, made it necessary for the Department of Commerce

through regulation, to impose compulsory silent hours of from eight to ten-thirty P.M., local standard time, and during local church services on Sunday mornings, on all amateur stations.

MORE LABORS FOR THE INSPECTORS

IN NO time at all, a new flood of letters poured in. The amateurs were accused of violating the silent period provision of their station licenses, particularly in points remote from radio inspectors where they thought they would not be apprehended. Nothing for it but the radio inspector must extend his day four or five hours more, and arrange to listen in nightly in an endeavor to locate the offenders. Congress would not appropriate funds for the necessary equipment, so, out of his own meager salary, the inspector purchased elaborate receiving equipment—often costing several hundred dollars—in order that he might efficiently serve his public. After a few weeks of such monitoring service it was found that much of the interference came from a number of broadcast stations transmitting on the same wave. Accordingly, Mr. Radio Inspector was called into consultation with his Chief at Washington. New regulations were drafted, providing a re-allocation of wavelength bands for broadcast purposes. These covered the wavelengths from 222 meters to 545 meters, and a zoning system was worked out to provide the minimum interference between stations.



EVERY RADIO STATION ABOARD SHIP

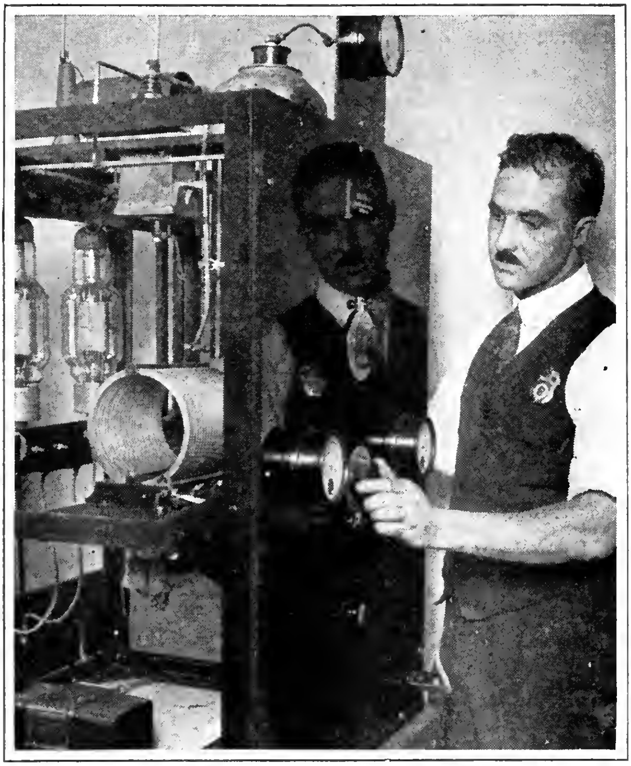
Has regularly to be inspected by the radio service of the Department of Commerce. The inspector checks the wavelength adjustment of the transmitter, and tests the storage batteries which furnish auxiliary power in case of accident to the ship's generators. He also tests the telephone from the radio room to the bridge. At practically all ports of entry in this country, the Department of Commerce inspects each ship each trip it makes into that port. This service alone would keep a large inspecting staff busy, but in addition to ship inspection, the inspectors have to inspect amateur stations of a certain grade, commercial shore stations, broadcasting stations, conduct license examinations for amateur and commercial operators, and investigate violations of the radio laws. The ship being inspected is SS *Maracaibo*

Returning to his office, the radio inspector with his insufficient clerical force, was faced with the task of explaining by letter to each broadcast station in his district the proposed changes, and calling in the numerous licenses for amendment. Relief from inter-station interference was immediate, but still the letters poured in, accusing amateurs of violations of quiet periods. Back to his receiver for Mr. R. I. And this time the problem had taken a new and more serious form. American and foreign ships were causing a tremendous amount of interference, practically blanketing the entire country, with their transmittals on 300, 450 and 600 meters.

REAL CODE INTERFERENCE

THE problem this time was very real. A quiet period could not be imposed upon commercial radio services to accommodate those who wished to be entertained. Furthermore, radio was the only means of communication from shore to a vessel at sea. Recourse to the laws showed that the transmittals were within the requirements in every way It was then decided to *request* the radio operating companies to have their vessels keep away from 300

and 450 meters, at least between seven and eleven P.M. daily. An additional wavelength of 706 meters was provided for them, away from the broadcast band. Theoretically, this was ideal, the companies expressed their desire to coöperate and—the individual operators going to sea used what they saw fit in regard to wavelengths available. Accordingly, practically no relief was noted. This was communicated to the complaining parties as fast as letters of complaint arrived. It was inconceivable, even to the most intelligent people, that a little vessel, tossing on the waves hundreds—even thousands of miles from their firesides could raise such havoc. It was so much more readily understandable how an amateur in the same town could cause the interference. Accordingly, the radio service was often accused of being in league with the amateurs against the broadcast listeners, or "BCL's" as they grew to be known.



INSPECTING A BROADCASTING STATION

WEBJ, the Third Avenue Railway station in New York, being tested by a radio inspector from the New York, or Second Radio District. The wavelengths of all broadcasters are very carefully watched by the government inspectors

DIPLOMACY AMONG THE INSPECTORS

THE radio inspectors then adopted new tactics. When a complaint against an amateur station was filed, the complainant was requested to furnish the name and address or official radio call letters of the offending station. Where they could do either, the amateur was directed by the inspector to get in touch with the complaining party and endeavor to come to some amicable agreement. Where call letters or names were lacking, the complainant was respectfully requested to get this information before it would be possible to assist him.

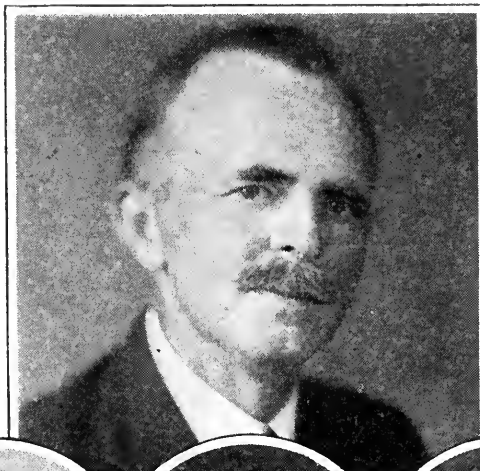
Contrary to being a practical solution, letters from the amateur side began to increase. It was claimed that no understanding could be reached with the BCL's; they were for total elimination of the amateur. After such conferences, the amateur naturally went away in a "huff" leaving bad feeling on both sides. This often took more active form and many were the tales of amateur antennae cut down in the dead of night. It was a feud second only to some of the old Kentucky gun-fights between the mountaineers. And between them both, fired at from both sides and with no support, stood the radio inspector, sleepless and irritated beyond description, but still struggling to bring peace into this big new family that had been suddenly placed under his wing.

The flood of mail continued. Level headed, clear thinking business men made threats over their signature that they would be ashamed of in any other connection than radio. Fair-minded, ordinarily pleasant people became most selfish and bitter.

When all other methods had been exhausted and still the public clamored for relief, official Washington decided that a general conference of all representative radio interests might solve the problem. Accordingly the Supervisor of Radio at New York was directed to call such a conference. Representative men from the radio operating companies and all those who were so connected were invited. The outcome of such an extended

discussion was an agreement by the radio operating companies, to eliminate the 450 meter wave on their vessels, accept the 706 meter adjustment in its stead, and to use 300 meters only as required by International regulation.

The rest given the inspectors was not for long though, for it was soon seen that in order for the broadcast stations to function properly and with little interference between one another, they must be maintained on their exact wavelength. It again became necessary for



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W. D. TERRELL

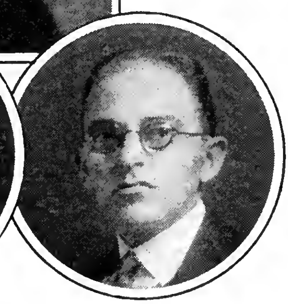
Chief Supervisor of Radio. Mr. Terrell is in direct charge of the inspection activities of the Radio Service, Bureau of Navigation, Department of Commerce. The country is divided into nine radio districts, each with its supervisor and inspectors. The task of administering the radio law has grown to tremendous proportions since the beginning of broadcasting in 1920

O. R. REDFERN

Supervisor of Radio, Seventh District. With headquarters at Seattle, Mr. Redfern has charge of radio affairs in Oregon, Washington, Idaho, Montana, Wyoming, and the Territory of Alaska

R. Y. CADMUS

Supervisor of Radio for the Third Radio District. His office is in Baltimore and with some exceptions he has control of the states of New Jersey, Pennsylvania, Delaware, Maryland, Virginia, and the District of Columbia



CHARLES C. KOLSTER

Supervisor of the First Radio District at Boston, which comprises Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut

the radio inspector to return to his monitoring of the air, this time to check the wavelengths of the broadcast stations and to notify those which had slipped from their assigned frequencies. This service proved so valuable, both to the broadcast stations and the listening public, that it is being maintained voluntarily by the various district Supervisors who are devoting their entire evenings to such work in order that you may have better broadcasting. There is no additional remuneration for this work, it is entirely voluntary. And remember too, that except in rare cases, where sufficient money could be "borrowed" from other office appropriations, the radio inspector has bought and paid for, from *his own pocket*, the receiving equipment which he uses for these measurements, and it is far more selective, far more costly than what you term a "good" broadcast receiver. It has to be.

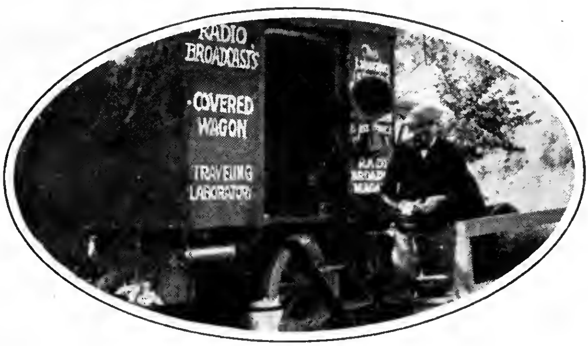
The devotion to duty of the men in the service is remarkable. The writer will always be grateful for the year which he was privileged to serve among them. The salary is insignificant. Much more has been tendered the inspectors by outside firms, but the majority prefer to stay and conquer your problems and to take such satisfaction as they may find in the fact that they are beyond a doubt doing more to give you better radio than any other individual or group in the art. Think of them as human, and think twice before you write a hastily worded and sarcastic letter.

The Log of a Radio Hobo

The COVERED WAGON in the Middle West, Which Captain Irwin Calls a Radio Paradise—Radio and the Farmer—The Farm Offers a Great Field for Radio Salesmen—News of the COVERED WAGON on the Radio Circuit

BY CAPTAIN JACK IRWIN

SOMEBODY is asleep at the switch. When I started on my travels in the RADIO BROADCAST COVERED WAGON, one of the objects of the journey was to ascertain first hand from the farmer exactly what radio was doing to assist him in his business and to amuse him in his leisure. I have listened daily to the broadcasting of produce market reports and imagined that the farmers were equipped to receive this information, and the weather forecasts. What do we find? After traversing more than one thousand miles of highway through some of the finest farming districts of the Eastern and Middle Western states we find that less than five per cent. of the farmers are equipped with radio receivers. We looked for mile after mile in vain for the familiar antenna on farm buildings. We stopped frequently at ranches where the fields and buildings indicated prosperity and the outward signs pointed to luxury within, but seldom did we find what we searched for.



PREPARING A "MULLIGAN"

Better known in the army as "slumgullion." Captain Irwin and the WAGON at the side of a road in Kansas on his transcontinental trip

Inquiries made during these visits proved that it was not lack of interest in radio matters that led to the absence of radio facilities. In almost every case great interest was shown and a keen desire expressed by both old and young for a broadcast receiver. We have been asked over and over again what receiver was best adapted for a particular need. Fortunately, with the complete equipment we carry on the COVERED WAGON, we were able to make suggestions based in many cases upon results obtained on the premises of the people interested. Unlike many of the fans in the towns and cities, the rural prospective radio owner is not inclined to interest himself in assembling a receiver from parts made by himself or purchased. He prefers to learn of a complete manufactured receiver that will bring in reasonably distant stations. To such interested persons I have always put the same question. Have they searched for their requirements in the pages of radio magazines, or have they shopped for radio receivers in their visits to town? The answer has always been invariably the same. They felt that what they had read about radio only left them confused, and their visits to dealers made them more so, as the latter claimed such extraordinary receptive qualities for their product that the farmer was skeptical. In other cases we found prospective purchasers waiting for some immediate neighbor to install a set, which "he would do this fall" and if he was successful, well, "I guess we will get one like it." The army is not the only place they "pass the buck!"

THESE FARMERS SHOULD HAVE BUSY ANTENNAS

IT IS reasonable to expect that the conditions that I have found on the main traveled highways must prevail in less settled byways to which my limited itinerary does not permit a visit. I think that both the manufacturer and the retailer are overlooking one of the most promising fields in the radio business. Farmers are almost waiting to be convinced that the set offered to them is the one that will produce the results that they anticipate for their money. From the expe-

rience of the writer it would seem that the old itinerant tinware peddler with his wagon could be resurrected to advantage in the retailing of radio apparatus in rural communities. Without exaggeration, we could have sold our sets on our WAGON dozens of times after giving demonstrations in farmyards. It is my personal opinion that the dealer must devise other methods than those now prevailing to reach one of the most receptive markets open to the radio industry. The farmer may purchase almost every other commodity he equires by mail, but when it comes to a radio receiver he must be shown.

MUNICIPALLY OPERATED RADIO

I DISCOVERED in Detroit to what extent broadcasting was employed as a public utility. The COVERED WAGON arrived in that city on the eve of the annual international motor boat races. The evening before the opening day, several mysterious looking wagons were drawn up along the river bank, each shrouded in coverings that hid the contents. Subsequently we learned that these wagons were owned by the Detroit Parks and Boulevards Department and contained broadcast receivers, each with a huge wooden horn to be used in announcing the results of the races to the assembled spectators. We found that every public park in the city would be similarly furnished with such receivers. They had not been especially installed for the important motor boat events, but had been designed and installed by the municipal authorities to broadcast the band concerts from Belle Isle, one of the largest and most beautiful city parks in the world. By means of these mobile receivers and giant loud speakers, citizens of the city in every park or public gathering place in Detroit could enjoy the band concert. This utilization of radio saved the city the expense of furnishing several bands for its parks. The idea originated with General Heckle, Commissioner of Parks and Boulevards, who had learned from practical experience during his service in the war of the advantages of radio.

THE POLICE "STATION"

THE city owns and operates a transmitting station at police headquarters. From this station was broadcast frequently particulars of any crime. Every precinct station throughout the city was equipped with a receiver and loud speaker, thus enabling the officers on duty in each station simultaneously to learn of the details of newly reported crimes as they were filed at headquarters. For instance, as each stolen automobile was reported, the number of the license, engine, and the make of the car was broadcast with other essential information that would lead to its recovery. Officials assured me that a very large percentage of stolen cars had been recovered as a result of this up to date method. This station has the most appropriate call letters of KOP!

Another excellent use the city finds for this municipal station is in connection with the city owned street cars. The repair trucks and cars of the railroad are equipped with receivers operated with a loop. When a breakdown in the system occurs, the broadcast station calls the number of the repair crew responsible for that section of the road and supplies the particulars of the trouble and the locality. The police department has equipped several speedy patrol automobiles for rapidly transporting police reserves to the scene of such hold-ups. These fliers, as they are called, are also equipped with radio receivers that enable the crew to keep in constant touch with headquarters. Radio has been so successful in solving communication problems in the city management in Detroit that it is planned further to utilize the new system by extending its use to the public schools.

THE GREAT LAKES ARE A RADIO PARADISE

OUR journey has progressed as far as the Great Lakes, and we envy the diversified programs that citizens of this region of the Middle West enjoy. Not only are they plentifully supplied with excellent broadcasting stations in their own particular zone, but their central locality enables them, with even small receiving units, to bring in programs from the Atlantic and far West stations. While listening in for a couple of hours each evening, a fan can gather in a dozen or more excellent stations. The fact that the division of times also adds to their advantage enables the Great Lakes fan to obtain DX without sitting up until the wee sma' hours, as his brother fan in the East must do. While the night is yet young he can hear the Atlantic stations sign off and turn his dials for Western stations working, say, on mountain time. At this time I am particularly enjoying these advantages. We have been most anxious ever since commencing this trip to obtain distant stations in the particular spot we happened to be each night. Prior to our arrival in the Great Lakes district this entailed much hardship in the loss of sleep, which we particularly needed after driving all

HALF WAY POINT

The COVERED WAGON on the Liberty Highway, 1,576 miles from New York and 1,563 miles from San Francisco. It was in the Middle West and West that Captain Irwin found the farmers so very much interested in radio, but so poorly supplied with sets.

day in the exhilarating country air, and even when we succeeded in warding off friend Morpheus we feared to disturb our temporary neighbors should there be fellow tourists near us. Excellent as broadcast music may be, there is a time and place for the best things, and a tired tourist camp is certainly not that place.

THE AUTOMOBILE TOURISTS

SPEAKING of our audiences, although the weather for the last two weeks (I am writing in early September), has been very chilly, we continue to meet thousands of automobile tourists. Some are *en route* home, but many are still touring. Each night as we camp in a new locality, each farther west, we are surrounded by a number of tourists whose license plates indicate that they are from north, south, east, and west. Wonderful companions on the trail they are. As I remarked in another article, I find it hard to write only of radio topics. The intensely interesting personalities we meet will long be remembered. Before I began this tour, I had read in a magazine devoted to outdoor life that in 1923 the estimated number of automobile tourists numbered several hundred thousand. I remember that the actual number seemed incredibly large and I made a mental note at the time that the writer had exaggerated, but my personal experience to date indicates that 1924 will exceed that estimate of last year. Now of the thousands we have met, we have not encountered a dozen carrying radio receivers. Even those who do possess receivers in their touring equipment do not use them often. A very large number are ardent fans and speak enthusiastically of their receptive feats at home. These tourists are very substantial citizens and the equipments are marvelous in ingenuity.

Some of the cars resemble furniture moving vans. Heads of happy smiling youngsters may often be seen protruding from an automobile load of camping equipment. Mr. Ford, if he could take such an extended trip as we now are enjoying, would have food for thought if he could but see what his efforts have led to! So far I seem to have encountered two outstanding classes of tourists. One is the substantial citizen already alluded to, the other is the itinerant worker who travels in the lowly, often ancient and dilapidated Ford, works for a period in one place, accumulates enough capital to carry on to his next objective point, and then repeats the process. Both are well informed, not on world topics perhaps, but upon American national problems.

In every tourist camp men and women foregather from every state and exchange amicable notes upon their diversified experiences. Two great inventions have brought Americans together, the automobile and radio.

The International Broadcasting Tests

Last-Minute Facts About the Plans for International Broadcasting During the Week of November 24th to 30th in the Tests Conducted by RADIO BROADCAST

BY WILLIS K. WING

BY THE time this copy of RADIO BROADCAST reaches the hands of the reader, the International Radio Broadcast Tests will be ready to start. The week of November 24th to 30th is destined to remain long in the minds of radio fans because the plans this year insure thrills for the listener that can be secured in no other way. Every important broadcasting station in the United States, Cuba, Porto Rico, Hawaii, Canada, and Great Britain will be "on the air" during their allotted time in the test week.

We have often been asked exactly what the purpose of these tests is. Last year, the transatlantic test was primarily to find out whether or not the ordinary super-sensitive receiver could bring in the English broadcasters, if American transmitters on the same wavelengths were silent. We purposed also to allow the English listeners to hear American broadcasting under the most favorable conditions of time and atmosphere. Both aims were achieved, as radio folk on both sides of the water will assure you. American broadcasting was heard in England very generally during the tests last year. It was about one month after that that the British broadcasting company successfuly rebroadcast the programs of KDKA over their own circuits.

© *Life;* from a recent issue

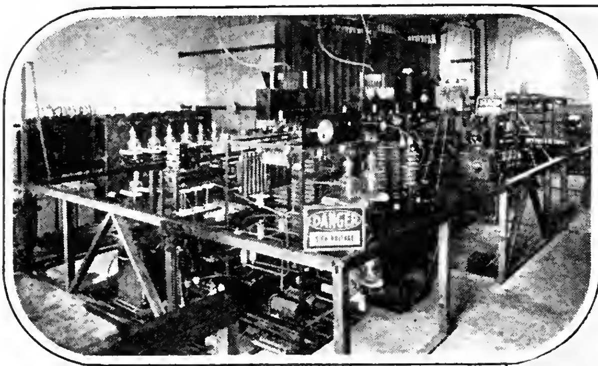
"OH BOY! I'VE GOT SCOTLAND"

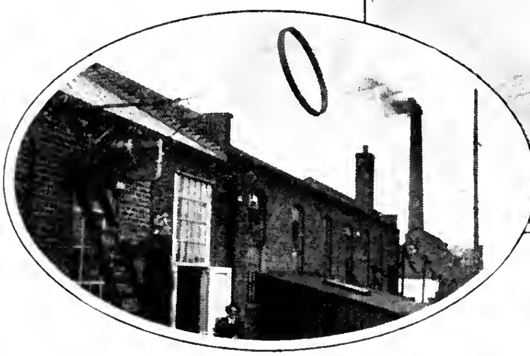
It is an established fact that listeners on each side of the Atlantic can hear the other, given highly sensitive receivers and favorable conditions. But those conditions have to be supplied. American listeners cannot hear English and Continental stations while their own broadcasting stations are sending on about the same waves. So, during an hour each evening of the tests, American listeners can tune-in on the foreign broadcasts unhampered by interference from United States stations. Listeners will have another opportunity to try their sets under conditions which could be found at no other time. After all, it is an experience for a listener in an isolated spot in Oregon to hear a program direct from London. That is just what happened in the tests last year. All the thrilled listeners were not in Oregon, either, for our reports, tabulated after the tests were over, showed there were great numbers of successful listeners in every state in the Union, and all the provinces of Canada.

FEATURES OF THE TEST THIS YEAR

THE International Esperanto Society is deeply interested in the potentialities of the International Tests and they have arranged to put on a brief program in Esperanto from at least ten important American and Canadian stations.

The proponents of this language feel that the tests will give them an unusual opportunity to put their international language to a





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COÖPERATING IN THE TESTS

Is the new Chelmsford station (5XX) of the British Broadcasting Company. The power is a maximum of twenty-five kilowatts, sent out on a wavelength of 1600 meters. The mast is 400 feet high. The oval shows the large lead-in insulator. The other insert shows a portion of the transmitting apparatus. Listeners here whose receivers will tune up to 1600 meters should hear 5XX

practical test. They have arranged that members of their society in foreign countries will listen for the programs. Many who have given thought to radio problems have felt that with the increase in international broadcasting, it might soon become a serious question whether or not an international language were not a necessity.

Program directors of all the stations have been hard at work making a special effort to have the best talent they can muster before the microphone during this week. Last year, it will be remembered that such persons of importance as Secretary of State Charles E. Hughes, Owen D. Young, General James G. Harbord, Henry Ford, and others spoke to the British listeners. Similar events of importance will take place this year. Marconi himself spoke in England last year.

The staff of this magazine has visited broadcasting stations personally in the eastern part of the country. The editor, Arthur H. Lynch, recently completed a trip which included the Marconi and *La Presse* stations at Montreal, CKCO at Ottawa, CKAC at Toronto, and WGY, Schenectady. The writer visited, among others, WGR at Buffalo, one of the stations which was successful in getting its signals to England last year, WWJ, at Detroit, WJAX, and WTAM at Cleveland. Short addresses were made over the air at most of these stations, telling of the plans for the test.

DETAILS ABOUT THE TEST

AMERICAN stations will open the test, beginning their transmissions at ten o'clock, eastern standard time on the night of November 24th. Promptly at eleven P. M., eastern standard time, they will all close down, and the foreign stations will send. The Pacific Coast broadcasters, then, will begin their programs at seven o'clock, local time, which corresponds to the Atlantic Coast stations' start at ten. American stations will send for an hour and remain silent for the hours specified each evening.

On the next page are the call letters and wavelengths of the English stations. American stations whose wavelengths are nearest to that of the English station are indicated in the last column.

When you know the dial adjustment of your receiver for the American station whose

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AT THE WASHINGTON RADIO CONFERENCE

Commander E. C. Edwards, Supervisor of Canadian Radio, Captain P. P. Eckersley, Chief Engineer of the British Broadcasting Company, and Arthur H. Lynch, Editor of this magazine, and organizer of the International Radio Broadcast Tests. Mr. Edwards, Captain Eckersley, and Mr. Lynch completed arrangements for the November tests at a recent conference in Washington

wavelength is nearest that of the foreign station, a minimum of time will be lost in adjusting your receiver to the foreign stations.

WHEN YOU HEAR THE FOREIGN STATIONS

ELABORATE plans have been made at Garden City, at the RADIO BROADCAST Laboratory to receive the foreign programs. Another special receiving laboratory has been set up on the seashore, away from all radiating receivers and power-line noises, so the programs can be received and accurately checked. Direct radio connection with London will be possible through a control key at the Laboratory connected to the high-power transmitter of the Radio Corporation of America at New York. Each evening, we shall make up a report of those listeners in all parts of the country who report to us that they heard the foreign programs. These will be quickly tabulated and rushed by radio across the Atlantic.

Every listener, no matter where he is, is asked to send a prepaid telegram to RADIO BROADCAST magazine when he hears a foreign program. The telegram should contain the name and address of the sender, the name and call letter of the sending station, and any necessary facts about the program heard. Those who live near enough may telephone their reports to the office of the magazine at Garden City 800. We shall also be glad to have reports by letter when you receive the test programs. All communications will be acknowledged.

WHOLESALE COÖPERATION

THESE tests have been made possible by the coöperation of the American, Canadian, and English broadcasters, the Radio Corporation, the General Electric, the Westinghouse Company, and the London *Wireless World.*

STATION	CALL	WAVELENGTH	AMERICAN STN.	WAVELENGTH
Paris	PTT	450	WMAQ	448
London	2 LO	365	WEBH	370
Chelmsford	5 XX	1600		
Aberdeen	2 BD	405	WOR	405
Birmingham	5 IT	475	WFAA	476
Bournemouth	6 BM	385	WGY	380
Cardiff	5 WA	351	WCBD	345
Edinburgh	2 EH	325	KDKA	326
Manchester	2 ZY	375	WEBH	370
Liverpool	6 LV	318	WGR	319
Newcastle	5 NO	400	WHAS	400
Sheffield	6 FL	303	WEEI	303
Plymouth	5 PY	335	WBZ	337
Leeds	2 LS	346	WLS	345
Brussels		265	KFNF	266

WHEN YOU WRITE THE GRID . . .

Don't fail to enclose a stamped, self-addressed envelope with your inquiry if you expect a personal reply.

Don't be impatient if you do not receive an immediate answer. Every letter is answered in the order of its receipt. Do not send a second letter asking about the first.

Look over your files of RADIO BROADCAST *before asking a question which might have been covered in a previous issue.*

Don't ask for a comparison between manufactured apparatus. The addresses of manufacturers of articles used in the construction of apparatus described in RADIO BROADCAST *will be given on request.*

Don't include questions on subscription orders or inquiries to other departments of Doubleday, Page & Co. Address a separate inquiry to the Grid.

Don't send us a fee for answering your questions. The Grid Department is maintained for the aid and convenience of readers of RADIO BROADCAST *and there is no charge for the service.*

QUERIES ANSWERED

WHAT IS THE CORRECT VALUE OF RHEOSTAT TO USE WITH A UV-201-A TUBE?
G. M. F. Tulsa, Okla.

HOW MAY I APPLY A FINELY VARIABLE NEGATIVE POTENTIAL TO THE GRID OF A VACUUM TUBE?
D. McG. Philadelphia, Pa.

DO GRID LEAKS AFFECT THE SENSITIVITY OF MY RECEIVER?
A. J. N. Keyport, N. J.

THE VOLUME OUTPUT OF MY RECEIVER IS DISTORTED. HOW MAY I CONTROL IT?
C. D. M. Waco, Texas.

HOW IS A C BATTERY INSERTED IN AN AUDIO-FREQUENCY AMPLIFIER CIRCUIT?
R. T. L. Augusta, Maine.

PROPER RESISTANCES FOR TUBES

WE HAVE been asked numerous times why 15- and 20-ohm rheostats are recommended for use with UV-201-A tubes. Likewise we ask, why, too. According to Ohm's Law R equals $\frac{E}{I}$, that is the resistance of a circuit is equal to the voltage supplied, divided by the current in amperes flowing through it.

According to the data supplied by the tube manufacturer, the resistance of the UV-201-A is 20 ohms. This figure is arrived at by dividing 5, the operating voltage of the tube, by .25 the current at which it is operated.

By applying the same formula we find that with a 6-volt storage battery the resistance of the circuit is 24 ohms. Since 20 ohms of this is to be attributed to the tube, the rheostat will necessarily have to take care of the extra 4 ohms. Therefore a 4-, 6-, or 10-ohm rheostat will be ample for controlling the tube filament.

In general, to find the resistance for any rheostat,

AN Ultradyne receiver operating in New York City easily tunes out the powerful broadcasting of WOR, Newark, N. J.—405 meters and brings in WDAR, Philadelphia—395 meters; PWX Havana, Cuba—400 meters; WDAF Kansas City—411 meters.

Regardless of close similarity in wave-length, the Ultradyne selects any station within range—brings in broadcasting clearly, distinctly, faithfully.

In addition to this Ultra-selectivity the Ultradyne is the most sensitive receiver known. It employs the "Modulation System" of radio reception, the achievement of Mr. R. E. Lacault, EE., A.M.I.R.E., Consulting Engineer of this company and formerly Radio Research Engineer with the French Signal Corps Research Laboratories.

The "Modulation System" responds to weaker signals than the conventional method of detection—because it provides greater rectification. Weakest signals are made to operate the loud speaker.

Ultradyne performance is the envy of the radio industry.

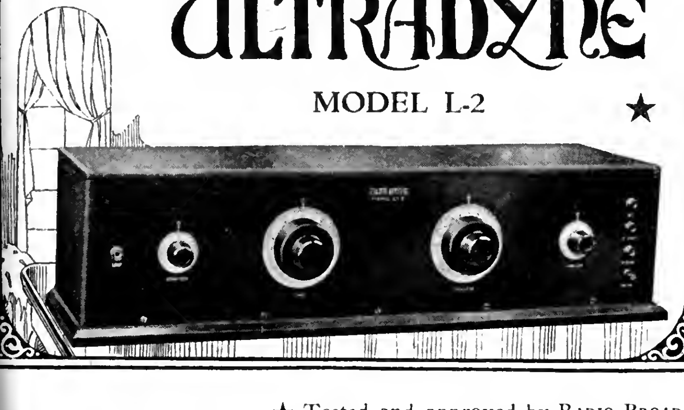
Write for descriptive circular

PHENIX RADIO CORPORATION

5-7 Beekman Street **NEW YORK**

ULTRADYNE

MODEL L-2 ★



Modulation Plus Regeneration in the New Ultradyne

To the "Modulation System" of radio reception, R. E. Lacault has successfully applied the use of regeneration in the new Model L-2 ULTRADYNE.

The result is ultra-sensitivity never before thought possible. The use of regeneration produces tremendous amplification which is more noticeable when receiving weak signals.

The Radio Section of the U. S. Bureau of Standards has proven by actual measurement that regeneration becomes more effective as the received signal diminishes in strength.

Regeneration applied to the "Modulation System" allows the ULTRADYNE to respond to an extremely small amount of energy. This energy is further amplified thousands of times by the intermediate frequency amplifier before it is detected and made audible. This amplifier is designed for maximum efficiency without decreasing the tone or quality of music and speech.

The reception of distant stations is only limited by atmospheric conditions and causes beyond the control of Model L-2 ULTRADYNE.

Loud Speaker Reception Using LOOP Aerial

Efficient loud speaker reception using a loop aerial is possible with the Model L-2 ULTRADYNE. Ordinarily loop reception is considerably less efficient than an outside aerial. However, the application of regeneration to the "Modulation System" reduces the resistance of the loop circuit, thereby allowing the loop to pick up infinitely weak signals.

The use of a loop also increases selectivity and decreases static and other interference.

How to Build the New Model L-2 ULTRADYNE

This 32-page illustrated book gives latest authentic information on drilling, wiring, assembling, and tuning the new Model L-2 Ultradyne. This book explains the "Modulation System" in detail and also deals with the application of regeneration to this new system of radio reception.

It is edited by R. E. Lacault, inventor of the Ultradyne Receiver. Price, 50c.

Model L-2 ULTRADNE Kit Is Ready

This is the new Model L-2 Ultradyne Kit which contains one low loss tuning coil, one low loss Oscillator Coil, one special low loss Coupler, one type "A" Ultraformer, three type "B" Ultraformers, four matched fixed Condensers.

R E
L

$30.00

The Ultraformers are new improved long wave radio frequency transformers, especially designed by R. E. Lacault, inventor of the Ultradyne. As a precaution against substitution, R. E. Lacault's personal monogram seal (R.E.L.) is placed on all genuine Ultraformers. All Ultraformers are guaranteed as long as this seal remains unbroken.

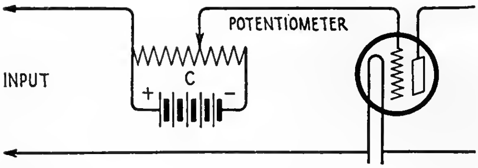


FIG. 1

substitute in the equation the voltage of the battery and the current rating of the tube. From the quotient derived, which is the total resistance of the circuit, subtract the resistance of the filament of the tube. The filament resistance of a tube may be ascertained by applying the equation to the operating characteristics of the tube, usually supplied upon the wrapper or tube carton by the manufacturer.

FINELY VARIABLE BIAS VOLTAGE

FOR applying a finely variable voltage to the grid of an amplifying tube or for controlling the voltage of a C battery similar to the method employed by Mr. Silver in his seven-tube super-heterodyne, we recommend the circuit shown in Fig. 1. The C battery is of the standard $4\frac{1}{2}$-volt type, the potentiometer 150, 200 or 400 ohms.

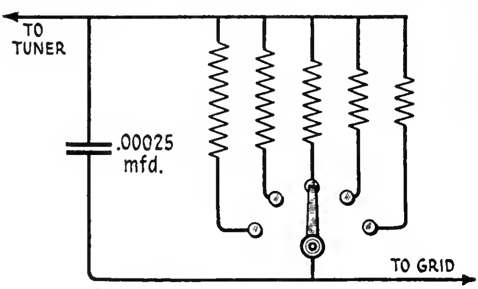


FIG. 2

GRID LEAKS

THE selection of a grid leak for your receiver requires care and judgment. Not all the variable grid leaks now on the market may be depended upon to give reliable service.

The importance of the grid leak may be understood when it is explained that the value of the leak controls to a large degree your distance reaching qualities. Strong, loud signals from local stations require a greater leakage to prevent the grid of the tube from becoming blocked.

Now, then, if this same large value of leak is used for the reception of weak, distant signals it is fair to assume that the signals will also be leaked out through the comparatively easy path the large grid leak offers. Therefore a variable leak, positive in its action, is necessary. We offer the suggestion as shown in Figs. 2 and 3 to this end. While the arrangement is not entirely economical, it is nevertheless efficient. Several grid leaks of various values are mounted as shown. The tap switch arrangement allows the proper selection of leak value for the station being received.

AVOIDING DISTORTION IN THE AUDIO OUTPUT

THE same device shown in Figs. 2 and 3 for a variable grid leak may be arranged to control the volume output of a receiver. For the values of leak shown, substitute resistance between 25,000 and 100,000 ohms (.025 to .1 megs). These are placed in the audio frequency amplifier circuit across the secondary of the transformer of the last stage. Overloading and distortion may be controlled with this unit. Any good continuously variable resistance may be substituted.

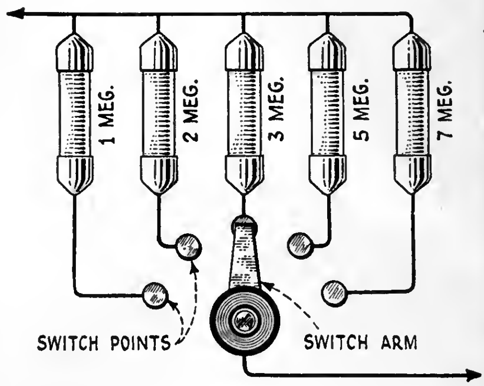


FIG. 3

THE C BATTERY

A METHOD for employing a C battery in a standard two-stage audio-frequency amplifier is depicted in Fig. 4. Ordinarily, the lower side or grid return of the secondary is connected directly to the negative side of the filament supply. But to insert the C battery, the lower side of the secondary is connected and then

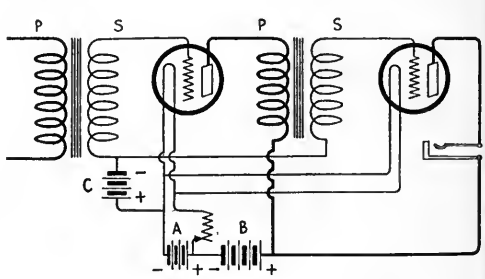


FIG. 4

brought to the negative side of the C battery. The positive side of the C battery is then connected to the negative side of the A battery.

It will be seen that instead of directly bringing the grid return to the negative A lead it is first brought to the C battery which is inserted in its position between the negative A and the lower side of the secondaries.

Eveready Heavy Duty "B" Battery, 45 volts. Three Fahnestock clips. Length, 8 3/16 in.; width, 4 7/16 in.; height, 7 3/16 in.; weight, 13 3/4 lbs. Price $4.75.

Dry "B" Batteries are more economical and more dependable than any other source of plate current!

REDUCE
Operating Costs

THOUSANDS of people are already cutting their "B" Battery costs one-half, or even two-thirds, by using the new Eveready "B" Battery No. 770 on their heavy drain sets.

This new Eveready Heavy Duty Battery marks a marvelous advance in reducing "B" Battery costs.

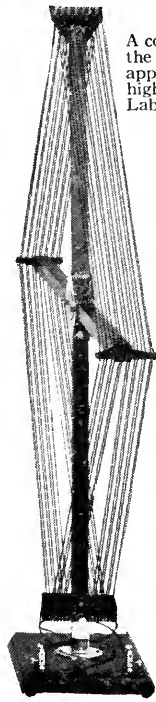
If your "B" Batteries have lasted only two months on a five or six tube receiver, this Eveready Heavy Duty "B" Battery will increase the service two to three times.

Use this Eveready Heavy Duty "B" Battery on any receiving set on which the "B" Batteries last less than four months. When thus used to its full capacity, it is the cheapest as well as the best source of "B" energy ever offered.

Manufactured and guaranteed by
NATIONAL CARBON CO., INC.
Headquarters for Radio Battery Information
New York San Francisco
Canadian National Carbon Co., Limited
Toronto, Ontario

★ **EVEREADY**
Radio Batteries
—they last longer

New Equipment

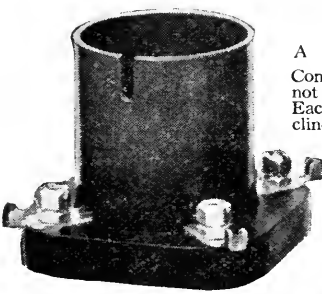


"FIAT" BANK–WOUND LOOP

A collapsible loop antenna of merit. The manner in which the loop is held rigid is very satisfactory. It is neat in appearance and of sturdy construction. The wood is highly polished mahogany. Made by the Radio Appliance Laboratory, 1529 Howard Ave., Chicago, Ill. Price $15

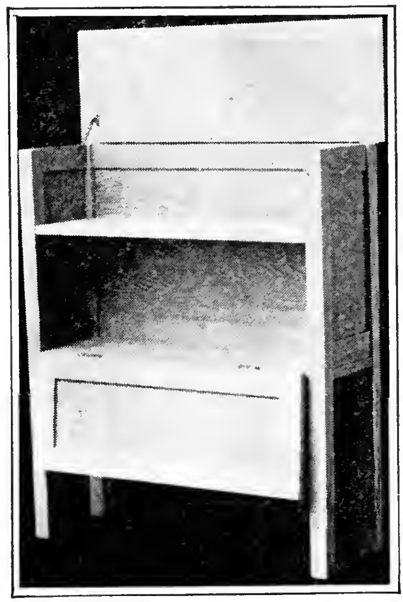
A LOUD SPEAKING TELEPHONE

Which gives exceptionally fine reproduction, is the Western Electric No. 540-AW. The projector consists of two cones of specially selected material resembling parchment. The apex of one cone is connected by a driving rod to an electro magnetic unit that responds to current impulses from the receiver thereby causing the cones to vibrate and reproduce the received signals. Made by the Western Electric Company, 195 Broadway, New York City. Price $35



A RADIO TUBE SOCKET

Constructed so that the tube does not have to be twisted into place. Each contact is a spring clip that clinches the tube prong without strain. The silver plated contact and respective lug is one continuous piece, doing away with binding post connections. Made by The Cutler-Hammer Mfg. Co., Milwaukee, Wis.

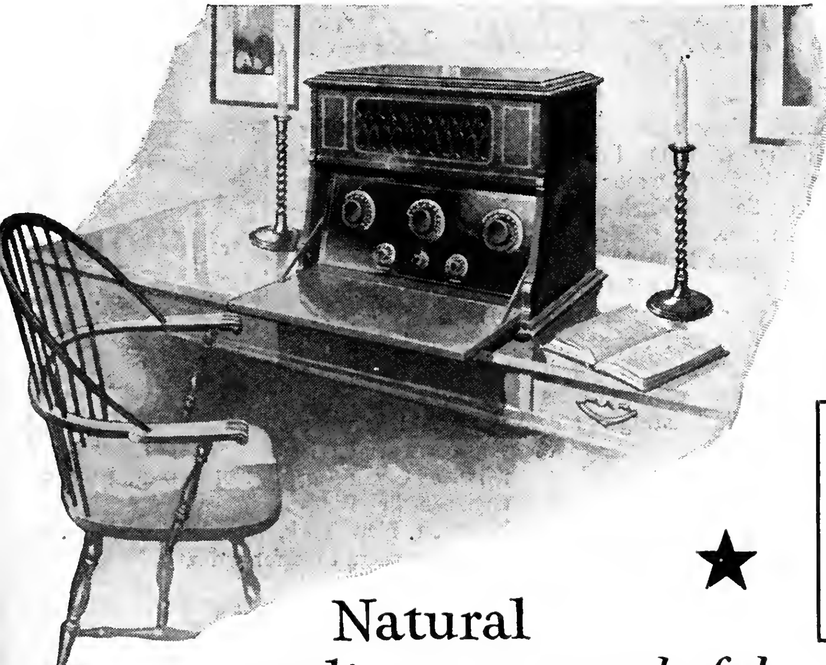


M–B–G RADIO CABINET

A moderate priced combination cabinet table with battery compartment. This arrangement is ideal for eliminating the confusion of batteries and wires in the radio corner. The manufacturer also makes a plain table and one with battery compartment. The purchaser can finish the table as he wishes. Made by the Express Body Corporation, 44 Lake St., Crystal Lake, Ill.

MORRADYNE RECEIVER

A five-tube receiver employing two stages of radio-frequency, detector and two stages of audio-frequency amplification. It delivers very good volume with fidelity. Tuning is sharp yet not critical. Made by the Morrison Radiophone Co., Inc. Bridgeport, Conn.



FADA Neutrola

Five-tube FADA Neutrodyne, with self-contained loud speaker. Genuine mahogany, artistically decorated with wooden inlay. Ample space for all batteries and charger. Drop when not in use. Price (exclusive of tubes and batteries), $220.

FADA

★

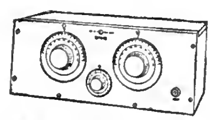
Natural tone quality - - - *wonderful volume with a* FADA Neutrola

In the "Neutrola," FADA has produced a radio receiver that possesses every essential to your complete enjoyment of radio. It is a new and better designed five-tube Neutrodyne set, refined to give the most faultless reproduction of music and voice. You can, without exaggeration, imagine yourself in the very presence of the musicians and artists. Selectivity is but one remarkable feature of the "Neutrola." With powerful local broadcasting stations operating, the "Neutrola" cuts through them and brings in outside stations, hundreds of miles away, on the loud speaker with minimum interference.

The "Neutrola" cabinet is of genuine mahogany, inlaid with a lighter wood. A decorative grill covers the built-in loud speaker, and a drop desk lid hides the panel when the set is not in use. The "Neutrola," is fitting company to the finest furniture in the home.

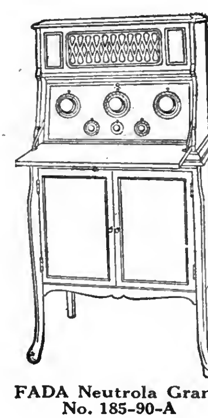
In adition to the "Neutrola" there are other FADA Neutrodyne receivers in sizes and styles to meet every desire; three, four, and five tube receivers in plain and art cabinets at prices ranging from $75 to $295, each extraordinary in results; each a remarkable value.

LICENSED BY INDEPENDENT RADIO MANUFACTURERS, INC.
NEUTRODYNE
REG. U.S. PAT. OFF.
HAZELTINE PATS. NOS 1450080 AND 1489228
PAT. MARCH 27, 1923 AND APRIL 1, 1924
OTHER PATENTS PENDING
F. A. D. ANDREA INC., 1581 JEROME AVE. N.Y.C.



FADA Neutro Junior No. 195

Three-tube Neutrodyne. A wonderful performer. Price (less tubes batries etc.) $75.



FADA Neutrola Grand No. 185-90-A

The five-tube Neutrola 185-A mounted on FADA Cabinet Table No. 190-A. Price (less tubes, batteries, etc.) $295.

F. A. D. ANDREA, Inc., 1581 Jerome Avenue, New York

FADA *Radio*

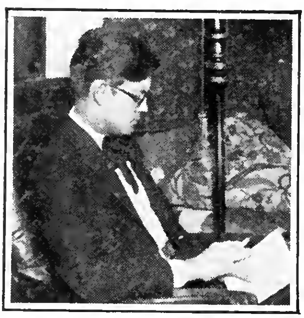
★ Tested and approved by RADIO BROADCAST ★

Among Our Authors

FRANK E. BUTLER, whose story "Making Wireless History With De Forest" forms the leading article for this month, is now radio expert for La Salle & Koch in Toledo, Ohio. It is quite true, we think, that radio men up to the present have been far too busy making radio history to take much time to write it. There are a number of other articles in this series which will appear in later numbers of this magazine in which Mr. Butler relates facts about early wireless struggles which are fully as interesting as any fiction.

JULIAN KAY is at present continuing his research work at Harvard University, and absorbing, so he admits, much of the good Boston atmosphere. He has written several more of his excellent explanatory articles which we hope to print in later numbers of the magazine.

AN EXTREMELY busy person these days is Zeh Bouck, whose constructional article on "A Knock-Out Amplifier" appears on page 226. For what with devising ways and means to escape hearing the flood of last-minute political radio oratory and doing his reulgar research and design at his New York laboratory, he asks us to judge if his time is not rather well filled. It is.



ZEH BOUCK

ANOTHER of James C. Young's interesting articles appears in RADIO BROADCAST this month. In the current WORLD'S WORK he has a story called "Breaking Into the United States." Most of Mr. Young's work appears in various New York newspapers.

SHORTLY after he graduated from Rensselaer Polytechnic Institute, Roland F. Beers, taught electrical engineering at his alma mater. He then went into the transformer design department of the Western Electric Company. He is now a consulting engineer in Binghampton, New York, where he manages to find some extra time for radio.

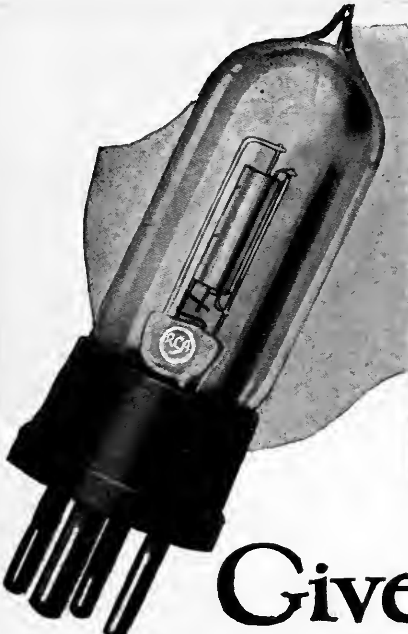
ROLAND F. BEERS

G. H. BROWNING, who with Mr. F. H. Drake, and Mr. Volney D. Hurd, produced the set which he describes on page 282, is in Cambridge, Massachusetts at the Harvard School of Engineering.

HOWARD S. PYLE, recently resigned from the Radio Service of the Department of Commerce and after several months spent as a radio consulting engineer is now one of the operators attached to the new Radio Corporation of America coast station WGO at Chicago.

HOWARD S. PYLE

THE article by Dr. W. H. Eccles on "The Importance of the Radio Amateur" which appeared on page 83 of RADIO BROADCAST for November, was reprinted through the courtesy of the *Wireless World and Radio Review* (London). We regret that a credit line to that effect was inadvertently omitted from the article.


RCA

THE ETHER HOG

Drawn from life, by Cartoonist W. R. Bradford, of the Philadelphia *North American*

"Oh, I am the hog of the air,
Wherever you tune, I am there;
I am the prize squeaker,
I fill your loud speaker—
The ether is free. I don't care.

RADIO BROADCAST

Vol. 6, No. 3 January, 1925

Sound: First and Last in Radio

The Romance of Radio—Radio the Superlative Degree of Communication—Sound and Radio—Importance of Scientific Knowledge of Sound in Broadcasting—A Discussion for Layman and Technician Alike

By B. F. MIESSNER

Consulting Engineer, Wired Radio, Inc.

"GENII," said Aladdin to the phantom who appeared as he rubbed his wonderful magic lamp, "build me a palace fit to receive my betrothed, the Princess Buddir al Buddoor. Let it be built of porphyry, jasper, agate, lapis lazuli, and the finest marble of various colors and surmounted by a dome of gold and silver. Let there be a spacious garden, a treasure house filled with jewels and precious metals, kitchens and store houses, stables and horses, and a royal staff of servants."

It was about the hour of sunset when Aladdin gave these orders and the next morning before the break of day, the Genii presented himself saying, "Sir, your palace is finished."

Who among us does not remember with delight this story from the Arabian Nights of the boy Aladdin and his wonderful lamp? He had only to rub his lamp and give his commands to the Genii who immediately appeared to obtain whatsoever his boyish heart desired.

If Aladdin were to come to life to-day he would rub his eyes and not his lamp, for millions of real magic lamps are in actual use in hundreds of thousands of homes. He would find the users of these lamps are not in a fairyland of myths and fables, but in a land just as entrancing and even more won-

THE PYRAMIDS OF CHEOPS

The secret of their building died with the dynasties that built them. Had modern arts of communication then been developed, the constructional marvels in building them would now be known

derful because of its reality. What would he think and feel, and say if you sat him down in your own home before your own magic box with its magic lamps, turned a few knobs and let him listen to the music and voices of half of the world? How could it be possible to hear these wonderful things and still remain at home?

In the twinkling of an eye you can take him on explorations over thousands of miles, from your own cozy fireside to the gay, bustling life of great cities, the shivering blizzards of the North, the languid summers of the South, or the quiet of the great West.

Can there be any among us with imagination so cramped or mind so rigidly harnessed to daily tasks that he cannot see and feel the romance and power of radio?

But now there comes among us a great and wonderful new thing that reaches us, not through the all-seeing eye attributed to God alone, but through an all-hearing ear—radio—which each and every one of us may own. The "Call of the North," the "Voice of the South," the "Heart of the West" all are here in the air we breathe, pervading even our very own bodies, wanting only the magic ear to translate their ghostlike presence into the living, breathing voices of song, of eloquence, of entertainment, of instruction or knowledge.

Something About Sound

Most of us have heard a great deal of talk about "distortion" in radio. That unfortunate word is coming in for a rather severe doing by a great many who have no idea what it means. It is running "efficiency" a pretty close race for the title of radio's most overworked word.

Mr. Miessner, the author of this, the first of a series of articles on the application of acoustics to radio, knows what he is talking about and has that rare ability in an engineer, of making his ideas understandable to others without first insisting upon a thorough discussion of something as remote as the fourth dimension.

Whether you are interested in radio technique or not you will find this accurate statement of fact entertaining and will, we feel sure, when tempted to criticize some flaw in the art, realize that astounding progress has already been made, and marvel with us at the wonderful results now being obtained by the contortions of two little diaphragms.

—The Editor.

RADIO LENGTHENS OUR EARS

In RADIO, we are developing a means through which the sense of hearing may come to mean more, perhaps, than vision ever meant. All of the value that sound and the hearing of it ever possessed, is now being multiplied thousands and millions of times by this new and wonderful servant, which finds its way into every nook and cranny of the world with the speed of lightning. This sixth sense reaches out over bounds and barriers and brings back to our own hearth stones, the voices and sounds of all the world. Radio is to the ear what the telescope is to the eye.

Progress is impossible without some means of communication, and in radio a new means of communication has been given to mankind. It is a far cry from the crude signalling of olden days, by smoke clouds, semaphores, or runners, to the telegraph, telephone and radio of to-day.

When one Indian, craftier than his fellows, discovered a method of chipping flint for his arrow heads, it took thousands of years for that bit of knowledge to spread over a single continent. What has become of the lost arts of the Egyptians in the rearing of the pyramidal tombs of their Pharaohs, in embalming, in glass making? Think of the tempered copper process of the Aztecs now lost to mankind, wiped out together with its creators, for the lack of means to spread their knowledge to the rest of the world.

The progress of the ages from stone, to wood, to iron, to steam and to electricity, is a story interwoven with the development of communication.

WHAT IF WE ONLY HAD SMOKE CLOUDS?

CONSIDER for a moment the effects on you and me, if we still had only the smoke clouds of the Indians, the runners of the ancient Greeks, or even the town criers of our own Colonial days instead of our telegraph, telephone, cables, newspapers and now the radio. What would have become of Watt's steam engine? It would surely have been buried where it was born and the age of steam might never have come over the world. What would have become of Lister's antiseptic, the printing press of the Chinese, Whitney's cotton gin, Dalton's atomic theory, Daguerre's photography, the motion picture, the phonograph, the flying machine, and the

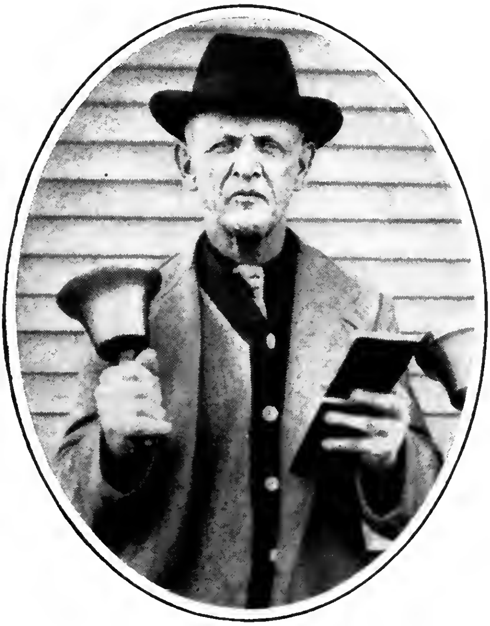
other stepping stones of our present existence? Where would we be along the road of progress, if Edison's electric light was still only common knowledge in the little community of West Orange, N. J.? How could our great cities and complicated modern life be possible if all the wisdom that individuals and groups have hewn out for themselves the world over were not made available to each one of us by means of our modern methods of communication?

Radio broadcasting is one of the really great developments of this rapidly moving age.

SOUND WE BROADCAST AND SOUND WE RECEIVE

RADIO as we know it to-day is primarily an acoustical instrument. The intelligence we send by radio is the intelligence conveyed by sound. The transmitting and receiving apparatus serve merely to transport sounds from one place to another or to many others. Its intricate electrical factors are merely a part of the whole whose one function is to reproduce *sound*. It is *sound* that we broadcast and *sound* that we receive. From microphone to loud speaker each part serves merely as a link in the chain which connects one place with another by *sound*.

The success of the whole scheme of broadcasting as an instrument of communication depends upon *how accurately* sounds in one place can be reproduced at another. To perfect the instrument then, we must concentrate our attention on this single purpose. We must understand the place of sounds in our own normal existence, know their nature physically, and how the links in the apparatus composing the broadcast chain fit this purpose. We must forget for a while the numberless variations of a few radio circuits, stop talking about batteries, distance, and other incidental matters, and spend some of our collective energy on the real fundamental thing we are most concerned with—the acoustics of radio.



©Brown Brothers

THE TOWN CRIER

Was the time-honored method of communication for a long period. He depended on sound, and to-day, we depend on sound, through the radio, the telephone, and the telegraph

Sound, though few of us realize it, exerts a tremendous influence in our daily lives. Of all the five senses, seeing, hearing, feeling, tasting, and smelling, hearing is surely one of the most important.

How many of us have ever stopped to think of this world of sound and what it means—how sound can tell us of the myriad things going on about us, the presence of which we might otherwise never know! We are constantly alive to these sounds—hearing them, classifying them—picturing the things producing them—interpreting them and their meanings—all without effort, subconsciously—automatically translating them into whatever meaning they may have for us.

SOUND RULES OUR DAILY LIVES

AS I sit here in my study with all my senses, save hearing, voluntarily cut off from the outside world, I can still retain a remarkable moving picture of what is going on about me as conveyed to my senses, alone through these subtle influences called sound. Because sound is a result of action, it is action or motion of some kind that we sense when we hear sounds. Every sound we hear is produced by motion of some kind. Nearly all sounds, therefore, are suggestive of action and are so interpreted as we listen.

Through my open window I hear a certain sound that is unmistakably the rustling of the leaves of a tree in the breeze. I hear an intermittent banging which is without question a carpenter hammering on a near-by house. A certain snip-snip tells me my neighbor is trimming his hedge—another whirring rattling noise says another mows his lawn. Shrill, trilling sounds tell of crickets,

other of frogs and birds or other insects, quite as clearly. A continuous characteristic rumbling and heavy bumping tells of an approaching automobile. Without seeing, I know it has stopped before my house, that the driver gets out, walks up to our door, raps on it, that the door is opened, that he asks for information, gets it, and departs! I can tell that it is an electrically driven car and know he goes on and not back.

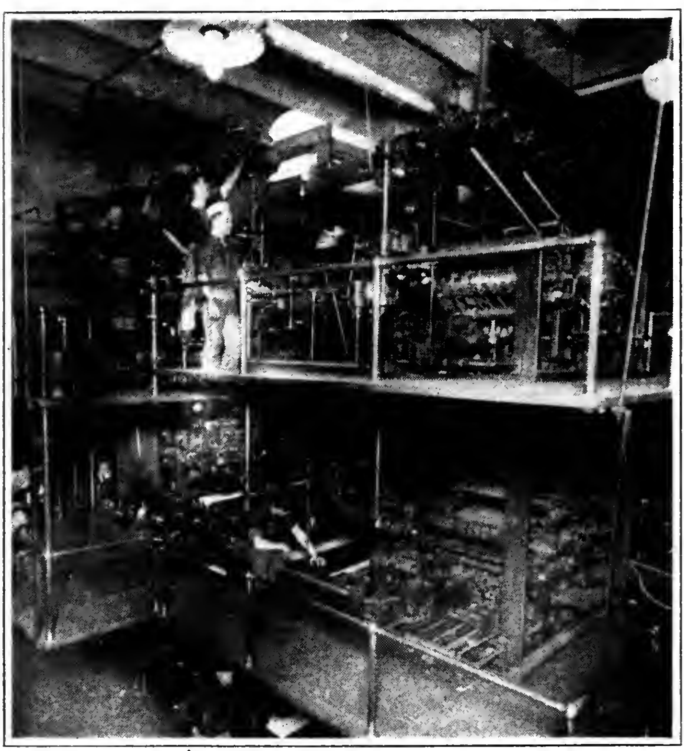
WE CAN ALMOST SEE BY SOUND

ANOTHER car approaches, getting louder and louder. The motor slows and I hear a slight creak of the brake; now the motor races furiously with a short grinding and whining and the motor again quiets with another brake creak; then another furious racing and grinding for a moment and as the pitch lowers these sounds weaken and disappear amid the other remaining sounds.

How do I know that this was a Ford motor car and that it turned in my driveway, backed out and around and went back the way it came? That is a difficult question to answer, but I am just as certain as if I had *seen* it with my eyes.

I hear other sounds that I know come from a piano. I know, too, that they come from a house across the street and am sure are produced by a player action and not manually. Only the three first beats are necessary to tell me that the selection is Rachmaninoff's "Prelude in C Sharp Minor."

Our sound memory retains accurate records of literally millions of different sounds just as our visual memory retains pictures of endless kinds and arrangements of visible objects. With vision we classify and distinguish obobjects by form, position, movement, surroundings, and color. By long accumulated experience we have grown proficient in the art of describing them by words. But with sound it is very much more difficult. We can describe the appearance of a pipe organ unmistakably, but to describe its sound accurately is quite another matter.



THE PRINTING PRESS

Of the newspaper and the magazine and the book spread intelligence today in quantity and efficiency undreamed of in earlier days. The knowledge of how to use the press filtered through Europe and America through the aid of greatly developed methods of communication

We can with relative ease describe a person with whom we are familiar, but are quite completely at a loss in truly picturing the sound of his voice. And so while we live all our lives in this world of sound hardly realizing its presence, it is constantly conveying a remarkably great and accurate knowledge of our surroundings, of the ideas our fellowmen wish to convey to us, and very much more besides by the association of ideas in the realms of the other senses.

Realizing this we become interested in sound objectively. We want to know what it is that we call sound, why sounds differ, and how we hear.

Most of all we are interested in sound because we are interested in radio. We have come to realize what a wonderful, far-reaching influence broadcasting is coming to have, and because we know that broadcasting is the art of instantaneous reproduction of *sound,* we

know that we must understand sound in order to reproduce it accurately.

Radio reproduced sound is *not* the same as the original and the degree of similarity varies with the character of the sound. Some sounds reproduce well enough that our understanding or pleasure in listening is not marred.

HOW RADIO CHANGES SOUND

OTHER sounds reproduce so poorly that we cannot understand or enjoy them. For instance, a banjo or violin, with the best equipment now available, are reproduced with considerable accuracy. The degree of similarity may be as close as that between a man himself and a good photographic likeness. However, in the man himself, many details can be observed which are not shown in the photograph. Likewise with these original sounds and their reproductions. Other instruments like the piano do not reproduce so accurately. Some tone ranges are good, others poor. The upper midrange reproduces well, but the extreme high and extreme low are poor. The very high notes are far too weak and the extreme low notes are much too thin and lacking in the powerful rounded smoothness produced by the piano tones themselves. Here the likeness may be as close, say, as a pen and ink sketch of the man; it is recognizable, but there is considerable detail missing.

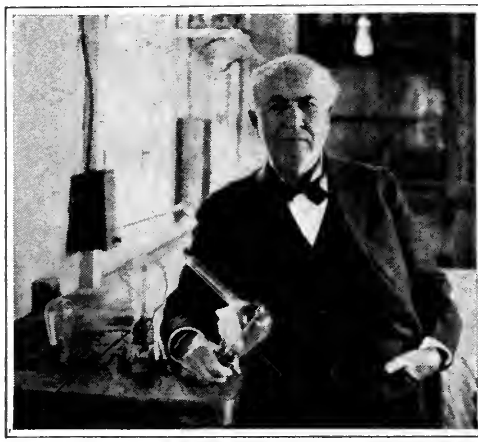
SOUNDS THAT RADIO DOES NOT REPRODUCE WELL

WITH the bass viol, the reproduction amounts to hardly more than a caricature, and it requires considerable imagination to recognize it.

In general, there is a lower level of loudness in the reproduced sounds for high and low pitches, and in somewhat the same manner very weak and very strong sounds are suppressed.

In a broadcasting studio we can easily hear the faint ticking of a clock across the room, but this would never be heard at a reproducing speaker. If a very loud sound like a pistol shot or drum beat were made with almost painful intensity in the studio, the reproduced sound intensity at a receiver would be greatly lacking in volume.

These differences between the reproduced sound and the original are caused by what we call distortions. They are produced in many different ways and cause a wide variation from the ideal true likeness of the reproduction for the original sound.

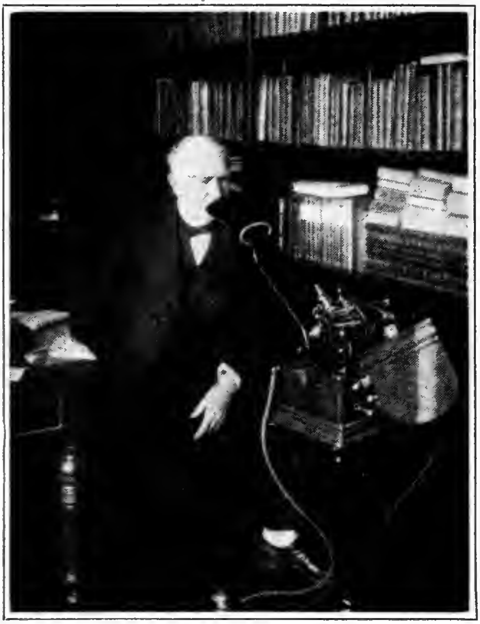


IF THOMAS EDISON AND HIS LAMP
Had been known only in West Orange, the world would still be backward in its development

Who has not viewed himself in a poor mirror or in those of a curved form such as are found in the large amusement parks? Who has not viewed moving pictures from a side seat near the front or looked through improperly fitted eyeglasses? What we see is sometimes a very grotesque and unnatural reproduction of the original which is due to incorrect relation of the various lines and parts one to another. Surely everyone has looked through colored glasses and has seen all colors save one subdued and that one accentuated. A ghastly example of such color distortion occurs in mercury vapor lamp illuminations as used in moving picture studios or factories. Color in Optics, and pitch in Acoustics are very similar, and very similar distortions occur in both.

SOMETHING ABOUT DISTORTION

IF WE take a mixture of all colors such as we have in sunlight or other white light and send them into a room through a colored window glass, the light in the room may be said to be distorted. Objects illuminated by it appear very different than in white light. If the glass be tinted only slightly the distortion may be small, and other colors may pass through in reduced intensity. But if the color be deep, only one color passes through and very great distortion results, such as occurs with the violet mercury vapor lamps. These give out monochromatic or one color light, and only that color in objects illuminated by it is visible.



©Brown Brothers

THE PHONOGRAPH

Is an excellent example of the development of communication and exchange of ideas by sound

A complex sound like that of an orchestra contains a very wide range of pitch in its tones and is similar therefore to white light in optics. If such a mixture of tones passes through a horn or diaphragm or other acoustic device which possesses a strong tone characteristic, the sound passing through will be distorted. If the tone characteristic is marked as in certain kinds of acoustic windows (glass globes with ear tube and sound opening) called Helmholtz Resonators, practically only one tone will be heard. All others will be suppressed and this one will be accentuated. Obviously, the distortion would be so pronounced that what was heard through the acoustic window would be only a very grotesque acoustic caricature of the actual music of the orchestra.

Horns, diaphragms, and various parts of the electrical equipment in a broadcast system possess this tone color characteristic which greatly influences the final reproduced sound. Furthermore, some sounds entirely absent from the broadcasting studio appear in the reproduction.

NEW SOUNDS IN THE RADIO RECEIVER

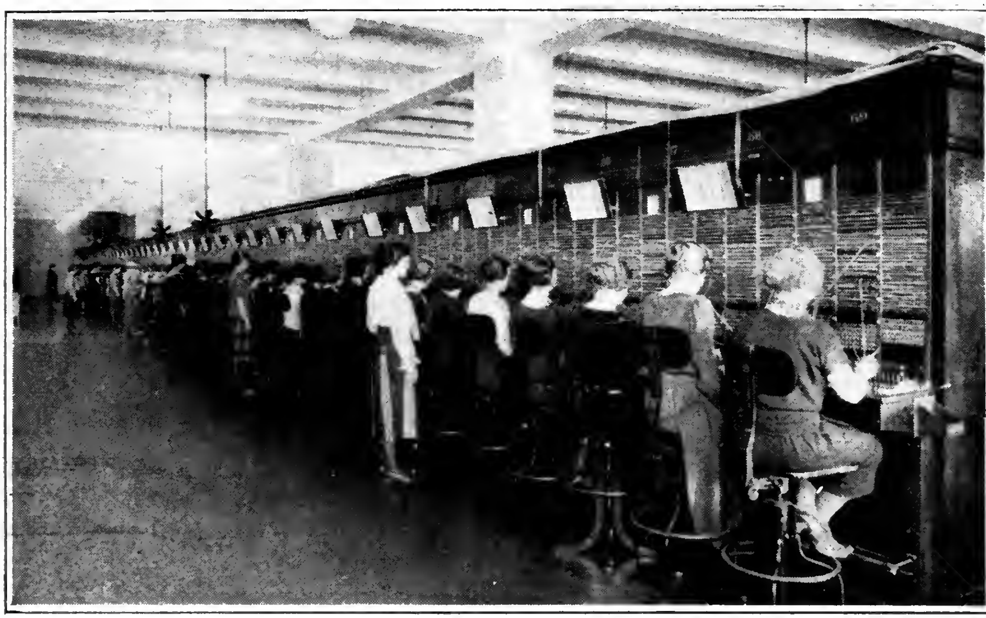
HOW serious this distortion is, few fully realize. But if one has things so arranged in a broadcasting studio that he can listen to either the original sound in the studio or to its radio reproduction from a loud speaker in an adjoining room merely by the opening and closing of a sound-proof door, a tremendous difference is apparent. Until the reproduction is indistinguishable from the original, the true object of broadcasting cannot be accomplished.

Realizing then that there is room for great improvement in the reproduction of sounds by radio, we must turn our attention first to the physical nature of sound, insofar as it is related to this process of radio reproduction, and then to the various elements of the radio system whose function it is to convert the sound energy into the various other forms necessary in radio and back again into sound. It is here that the inaccuracies and distortions in reproduction creep in. The original sound energy cannot itself be sent to great distances. Radio, a totally different kind of wave energy, is called into play. These radio waves have the peculiarly fitting property of being silent unless properly translated, and they can be sent to an unlimited number of distant localities at once.

Since sound waves cannot be converted directly into radio waves, other conversion steps must intervene. In some of these converting elements of the system, the original sound vibrations exist as physical or mechanical vibrations, in others, as magnetic or electric vibrations. In order to accomplish the final result, many transformations and retranslations of the energy occur.

When one considers the complexity of these processes, it seems remarkable that the final result is so good as it is. Consider for a moment a piece of fine literature of intricate grammatical structure with deep and wide emotional appeal. Let this be translated from, say, the original English first into Chinese, then from Chinese into German, again into Greek, and farther through perhaps a dozen such translations and finally again back into the original English. Would it be surprising if only the crudest outline of the author's meaning appeared in the final retranslation?

And yet, this is what, in effect, is done every day in the process of radio broadcasting and reproduction. The final translation into sound, considering the intricate nature of the process, retains a remarkable likeness to the original. For this degree of perfection thus far attained the major amount of credit must be given to those who have devoted their careful attention and attacked the problem as one of



IN THE TELEPHONE EXCHANGE

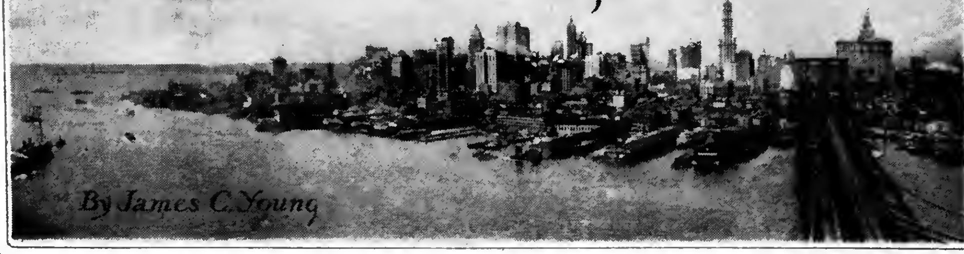
Enormous quantities of communication by sound pass every day. In wire telephony, as in radio telephony, we send out sound and sound we hope to receive at the other end. Too little attention in radio has been paid to the fact that we want perfect sound at both ends of the circuit

acoustics. Improvement in this art will be made only by a deeper study of the nature of sound and its relation to these many translating devices like the microphone, the amplifier, or the loud speaker which comprise the radio sound reproducing system.

A second article by Mr. Miessner will discuss in a most interesting fashion, the physics of sound. It will appear in an early number of this magazine.

Radio—the "Voice of the City"

By James C. Young



WHEN WNYC sends out its evening call from the high Gothic tower of the Municipal Building on lower Manhattan Island, it speaks with the voice of the only American city which commands a place "on the air." To put the matter a little differently, this is the single station owned and maintained by an American city. Perhaps it may seem strange that this should be the one truly representative municipal station at a moment when institutions of every sort are turning to radio with a sure instinct for publicity. But plans under way may be expected to result in several new municipal stations. A half-dozen others scattered across the country fall into this classification, although not directly owned by local governments. Thus it may be said that the day of the municipal station has definitely arrived; that the personalities of cities are to be made familiar throughout the ether.

This development brings far-reaching considerations. Some observers affirm that the municipal station will be freer of prejudices and restrictions than any other kind of station possibly could be; but another phase of public opinion holds that the political element is likely to become troublesome. Doubtless, the true estimate lies somewhere between these extremes. It is beyond question that the next year or two will witness the installation of municipal plants in growing numbers.

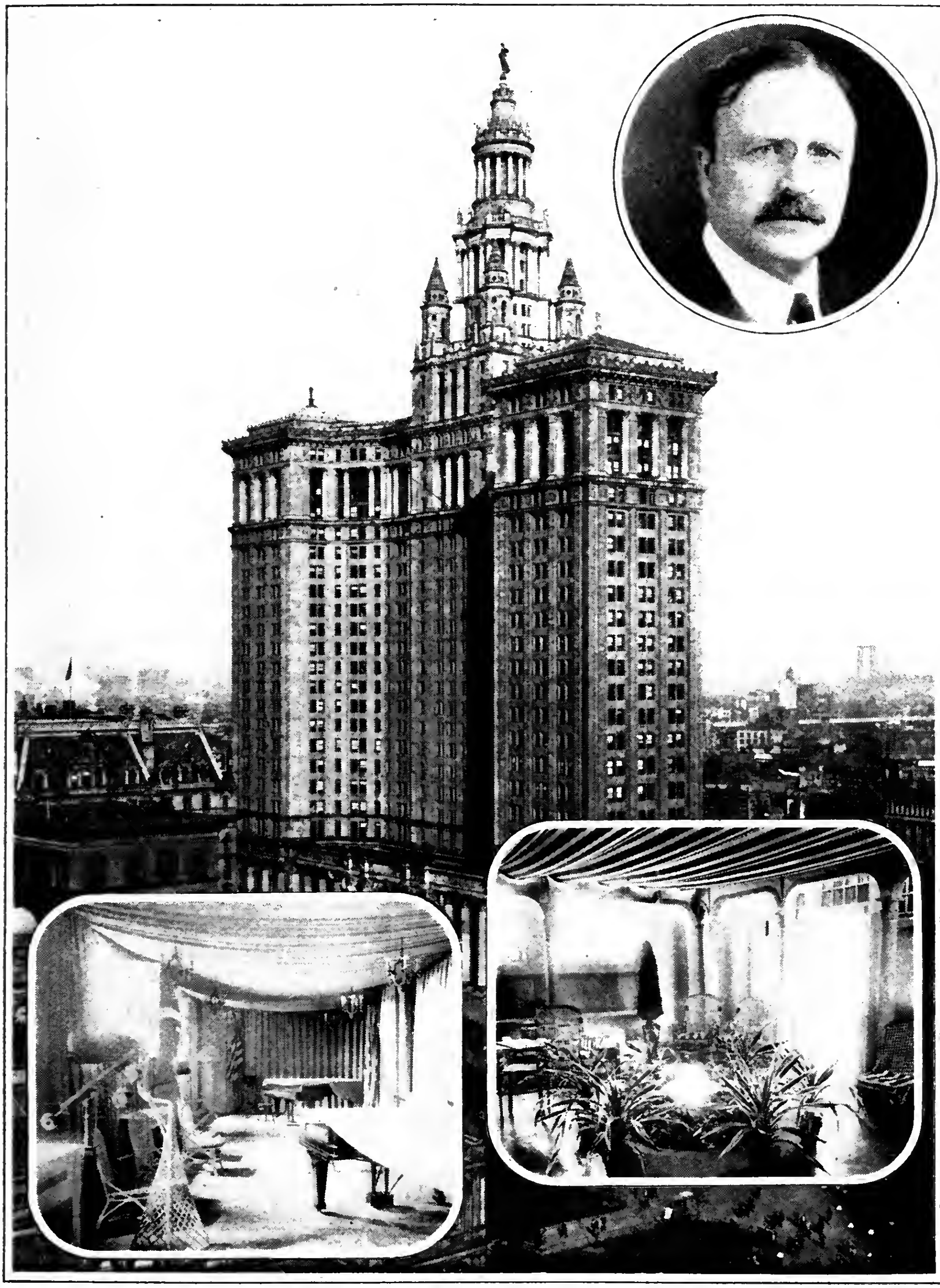
Long ago a famous poet asked the Roman populace to "lend me your ears." That same request is being made to-day in the name of American cities, anxious to command a hearing from the world, by means of radio. A forcible case in point arose when WLAG shut down in Minneapolis. Instantly the city government, the community's business men, and the community itself, felt the loss of prestige. An old friend had departed. Instead of the fair name of Minneapolis being wafted around the world every night, the microphone was silent, and Minneapolis suffered.

Such a condition could not be tolerated in a city so fair and hustling. A number of its citizens said that "something should be done about it," and presently something was done. The Washburn-Crosby Company, the big millers, offered to assume all liabilities in addition to half the cost of maintenance for three years, at $100,000 a year. Ten other business concerns came forward with the necessary $5,000 each, and now Minneapolis has its station going again, better than ever, perhaps; every night cities throughout the world may listen-in across the reaches of space when their neighbor entertains. Incidentally, St. Paul shares in this glory and the expense. Its quota of the $50,000 is 40 per cent.

WHERE MATTER DOES MORE THAN SERVE MIND

THE experience of Minneapolis is a typical instance of the associations that gather around a radio station. It is something more than a mere mechanical creation; indeed, this is a place where matter is harnessed in the service of mind. It is a poor sort of station that does not develop a definite identity in the consciousness of a multitude. If we reason upon the matter, we must see that this result cannot be escaped. Even the voices of announcers become so familiar that the absence of one for a night is promptly detected. When the personality of a man is so easily conveyed and understood, how much greater is the opportunity to spread broadcast the civic spirit which distinguishes many cities.

And cities throughout the land are beginning to understand the possibilities which await. Late they may be in starting, but it is likely that their alacrity in catching up will more than offset the delay. Boston is contemplating a station near the Parkman bandstand on



THE VOICE OF NEW YORK CITY

The New York Municipal Building. The top insert (photo © Underwood & Underwood) shows John F. Hylan, Mayor, under whose administration $50,000 was spent in purchasing the station. The two lower inserts show the elaborate reception room and studio of the station

Boston Common to be connected with all of the sixty-five parks in the city. Many of these parks are provided with stands for music and speakers in the summer months. It has been proposed so to arrange the system that a concert or address in any park could be picked up and radiated from the central station. Or a varied program might be supplied by means of selections from the several parks. At other seasons indoor programs would offer opportunity to let the world know that the spirit which once flared on Boston Common still lives in the breasts of its citizens, but now applied to peaceful pursuits.

Probably no station in the country can offer more of interest than WNYC, New York's own. Situated on the twenty-fifth floor of the Municipal Building tower, it has special advantages of location. At 7:30 P. M., when the station "takes the air," lower New York has fallen into its nightly slumbers, after an intensive day. No place in the country is so much like a deserted village as is this section at that time. The big pile of the Municipal Building rises up in serried floors, overshadowing City Hall Park and the lesser buildings gathered around.

WNYC
The cage antenna of the New York City municipal radio station atop the Municipal Building. The station first went on the air during the Democratic Convention and since has been the storm center for some acrimonious disputes. Mayor Hylan made an address about the transit situation, in which he attacked the Transit Commission. A member of the Commission demanded the right to reply from the same station, but was unwilling to have his speech censored by the Mayor. This was finally done, however

Away up in the tower, so far up that a man in the street below could not see the light, is WNYC. If a visitor be lucky and runs the gauntlet of elevator men, guards, and other functionaries, he arrives at the studio in time for a pleasant illusion. Stepping through the door of WNYC's own home means going from the marble and glass of an office building into a tented palace that seems to have been created for romance. There is a colorful awning suspended below the ceiling and brilliant cane furniture to match, with a fountain in the center where spraying streams converge over the changing hues of an electric globe.

It required a vision of the first order to conceive this station and carry out its installation. The conception was that of Grover A. Whalen, until recently Commissioner of Plants and Structures, and a prominent figure in the administration of Mayor John F. Hylan. Mr. Whalen suggested the plan early in the year. Mayor Hylan thought well of it. Other officials opposed. It would cost too much money, maybe a prodigious sum. But Mr. Whalen said that he wanted merely $50,000. But, it was objected, that would not even purchase the plant. "Give it to me," said Mr. Whalen, in effect, "and I will show you."

From that $50,000 WNYC was installed and developed. Mr. Whalen first cast around for a station. He found that the station used in Rio de Janeiro during the recent exposition there, would be sold. And he became the buyer, in the city's name. The whole apparatus was shipped to New York and set up again. The plant corresponds exactly to the former WJZ station in Newark, of which it is a copy.

The first program was sent out on July 8, 1924. And from that day, WNYC has held a well-defined place "on the air." By degrees its programs have been turned into a definite direction which differs widely from the average program, intended for entertainment only. It is the announced purpose of WNYC to mix a larger measure of instruction and enlighten-

ment with its entertainment. That effort has been carried forward with a degree of success which raises up many interesting possibilities for other municipal stations.

WHAT CAN BE DONE WITH THE STATION

JUST now a plan is under advisement which would link the station with all of New York's 632 schools, scattered through five boroughs, comprehending some 300 square miles of ground. If a lecturer endeavored to visit these schools, one a day for 300 days a year, he could not reach the last in less than two years. Therefore it is impossible for any instructor in the schools to extend his influence beyond a few. By means of WNYC he could achieve the work of two years in a half hour.

That is but one aspect of the station's educational plans. It is expected to open radio extension courses dealing with many themes, along the lines already laid down by a number of colleges. These courses will be devised to reach the adult public sitting by its fire at night. The other educational programs will be broadcast during school hours.

Still another avenue of development has been opened by invitations to workers in almost any field who have substantial achievement to their credit. Not long ago the returning Olympic athletes described from WNYC just how it felt to come back victors from Colombes, after winning from the first athletes of the world. Such a message was largely entertainment, with a dash of instruction. But on the next night, perhaps, speakers from this station discussed such a momentous matter as the future of New York transit, one of the city's most difficult problems. In this case the entertainment was small indeed, but it may be believed that the instruction was not without value.

The mission of WNYC is not always entertainment or instruction. It has a grim purpose in part. Every night at 7:30 and 10:30 a man in blue coat and prominent brass buttons sits down at the microphone.

"WNYC broadcasting," he says, "for the New York Police Department. General alarm for Harry Martin, age 30, 5 ft. 6 in. tall, weight about 140 pounds. Dark face, with bold fea-

HOW THE NEWS IS SPREAD

Important events are broadcast from the municipal radio station and others in New York, and picked up by receivers and amplified so that great crowds may hear. The photograph shows crowds in City Hall Park, New York, in the shadow of the Woolworth Building, listening to broadcasting. The city, Mr. Young points out, may accomplish real service, with a properly run broadcasting station

WHEN SOMETHING IS SAID, PEOPLE LISTEN

Digests of the meetings of the Board of Estimate and Apportionment, the Commissioners of the Sinking Fund, and the Board of Aldermen are put on the air from WNYC in New York on the days these meetings occur. Besides the more political elements of the city programs, they also contain the usual musical and oratorical features

tures and frowning eyes. Has a slight limp. Dangerous man. Escaped from Welfare Island early to-day. Believed traveling west."

The listener rather catches his breath at such use of radio. It is an eerie thing—this pursuit of a man by air. An observer wonders what chance there will be of detecting Harry Martin among all the other men in the country of that general appearance. But his speculations are cut short by a new description which the officer is spreading far and wide. This time another man is wanted. And presently it is another, until the department has sent out particulars of some twelve or fifteen men whom the law demands.

A surprising number of these are apprehended, not always directly by the intervention of radio, but its use has become an invaluable part of an intricate whole. In a number of cases radio has made it possible promptly to broadcast descriptions of dangerous persons, with the result that their arrest soon followed. No quicker method is known to criminal procedure, and it has the power of drama as well. Descriptions of missing persons also are sent out, about four a day. Not long ago a stolen automobile was captured by a policeman on Williamsburgh Bridge within twenty minutes after the number had been broadcast from WNYC.

WHAT OTHER CITIES ARE DOING

LEAVING WNYC, busily engaged in its high tower, the next radio plant which the United States Department of Commerce classifies as a municipal station, will be found at Stevens Point, Wisconsin, using the call signal WLBL, and operated by the Wisconsin Department of Markets.

The West is progressive in the matter of municipal stations, for there is another near by, in Omaha, conducted by the Central High School, and known to many listeners as WNAL. The Boise High School in Boise, Idaho, has a municipal station identified as KFAU. In Dallas, Texas, the Police and Fire Signal Department of the city government operates WRR, while the Detroit Police Department owns and operates station KOP, and there is a sixth station, KFPR, under direction of the Los Angeles County Forestry Department.

These six stations, with WNYC, are commonly classified by the Department under the title of municipal plants. But the New York station has the distinction of being the sole station directly operated by any city government. It is likely that a similar plant soon will "take the air" in San Francisco, where somewhat jealous eyes have been turned toward Los Angeles and its station. The city council and various business organizations there have the details under consideration. If the city does not install a station, it is believed that private enterprise will supply the need.

Municipal radio stations enjoy some peculiar privileges. One of these is the willingness of entertainers to contribute their services. Although many entertainers find radio so rich in prestige that they are willing even to pay for the opportunity of broadcasting, it is one of the unsettled questions confronting the public and the owners of stations, as to how these services shall be compensated. In the case of municipal plants it seems generally agreed that the stations do not yield a profit to anybody concerned, and entertainers more willingly extend their help. This is an important consideration that calls up many other questions which must be answered. As the municipal plants develop and the demand for radio entertainers increases, people will certainly compare the municipal station with the other stations. And so now we have the old question of governmental competition—in a new way.

THE GREAT AND SILENT VOID WAITS

INSOFAR as the political phase is concerned, there seems little reason to believe that any city administration would overlook such opportunity to sound its praises. That is not in the nature of things—human or radio. But it is just as certain that any fulsome use of radio to spread word of the deeds performed by Mayor What's-his-name would be likely to fall upon a great and silent void. The radio public probably makes up the most sensitive audience which any speaker could be summoned to address. Political propaganda is not wholly unwelcome, as evidenced in the recent campaign for President, where it was tested on a larger scale than ever before. But it soon was learned that the best political speech was the shortest, a policy rigidly followed by speakers of all political shadings.

There is no reason, of course, why a political address should be objectionable. On the contrary, it frequently is enlightening. Few matters have a larger influence on the welfare of the nation than its government, and politics is but another name for government. The political address properly is a part of radio. But when all this has been granted, it is even more certain that the American radio public would not yield its ears for even five minutes to the man who dispensed bombast about himself. So it may be believed that the good sense of the public will be the surest check on the misuse of municipal stations by spellbinders.

With so many advantages evident to city, nation, and public arising from municipal stations, it requires but one scant glance to perceive that a number of these stations will be added to the radio resources of the United States. Perhaps in time the municipal station will take the place, in some measure, of the numerous stations which have sprung up because there was nothing better in the neighborhood. It is a fair guess that the average municipal plant will draw about it the best to be had in any city, as concerns both entertainers and public confidence. Such stations inevitably will crowd to the wall others of uncertain status that merely fill a gap in the evolution of radio.

SELLING PRESTIGE

IT IS wholly conceivable, even distinctly probable, that municipal stations will be rapidly financed in some such manner as the Minneapolis station. If a similar proposal should be submitted to the business communi-

ONE OF THE TWIN CITIES

—Minneapolis, Minnesota. When WLAG recently closed, business men of both cities felt that civic pride and actual definite benefits both demanded that the locality continue to have a broadcasting station. They raised sufficient money to operate the station and WCCO is the result. Mr. Young points out that a city broadcasting station can give a very important idea of the character and advantages of the city to listeners in other parts of the nation

LISTENING TO POLITICAL BROADCASTING

Interested politicians during the recent Democratic Convention in New York kept tally cards of the balloting in Madison Square Garden. The municipal service may be extended beyond this, however. New York plans, for example, to broadcast market information daily to New York housewives. At a given hour each morning, housewives who own radio sets may tune-in and learn what foods are cheapest and what in the most abundance, and govern their purchases accordingly

ties of almost any city above 100,000, a plant would be the probable result. Proceeding along a slightly different line, cities may supply plants and call upon organized business to undertake maintenance for the common good. Whatever the method, it cannot be doubted that the municipal station will have a rapid expansion. There are so many evident advantages that it may be wondered why these stations have not come into their own long ago. But it need be only pointed out that the whole radio industry is so new and still in such a highly formative state that many goals are yet to be reached.

There is something of inspiration and much of glory in the thought that before the lapse of many years municipal stations strung across the country will keep American cities in intimate touch, day or night, through their own plants. The assurance that these will be operated for direct public benefit is one of importance. They never can be accused, as all other stations have been, of fostering private enterprise. Assuredly there is nothing to be censured in this enterprise, considered by itself, but wherever private interests enter, the possibility of criticism also must arise. Municipal stations will have nothing to sell—unless it be the prestige of their cities; and if some candidate occasionally oversteps the bounds of radio, he may depend upon a prompt tuning out, his worst punishment.

The prediction is familiar that the number of commercial stations must decrease rather than expand. But despite the closing of some stations the number has gone steadily upward instead of down. Even with the stations now projected, it is probable that this expansion soon must reach its logical working out. And the moment additional municipal stations are opened, the pressure on weaker commercial plants will be hard to resist. It is likely that municipal enterprise will help to correct a condition that has caused some concern. In any event, an America girded with plants owned by its cities will be a fine evidence of civic spirit; a spirit which well may serve to draw the whole nation closer together by the invisible bonds of the air.

HELP FOR THE EXPERIMENTER

A NEW department will appear in RADIO BROADCAST *regularly which contains helpful contributions from readers. We have had many excellent suggestions about little kinks of construction which were proved so helpful that we think all our readers ought to share in them. We invite contributions which must be typewritten and not over three hundred words long. We are not interested in freak ideas but will only consider those which are of decided value. Payment of between $5 to $10 will be made for each suggestion accepted.*

A Motor-Generator Unit for Radio Battery Charging

How to Assemble a Simple Mechanical Unit, Efficient, and Particularly Low in Upkeep—The Parts are Easy to Secure

BY JAMES MILLEN

IN PRESENTING this construction article on the building of a battery charger, RADIO BROADCAST feels that it is giving to its readers a device of great value and usefulness. While the method here described of charging storage batteries is not by any means new, Mr. Millen has simplified the motor-generator charging method in usable form for the average radio fan. This charger is comparatively cheap in first cost and upkeep, and what is highly important, will charge a set of radio, or any other batteries much more quickly than usual methods at the command of the radio enthusiast.
—THE EDITOR

MANY radio fans have no doubt often desired a more rapid means of recharging their storage A batteries. As, at best, a storage battery delivers only 75 per cent. of the energy fed into it, it will take longer to charge the average battery by means of the ordinary two-ampere charger than it will to discharge the battery when used with some of the modern multi-tube sets. Of course the so-called five-ampere chargers will do the job more quickly, but they are both more noisy and more expensive. The approximate time required to charge a 100 ampere-hour six-volt battery by means of several of the chargers in most general use is given in Table 1.

It is a well known fact that the motor-generator is one of the most efficient and rapid methods of battery charging, but due to the high initial cost of such machines, they have never come into popular use.

The purpose of this paper is, therefore, to describe the construction of a motor-generator type charger which can be made from standard parts which ought to cost no more than the best of the five-ampere type chargers now on the market. Such a motor-generator will completely charge an empty 100 ampere-hour battery in about twelve hours at a total cost of about twenty-five cents for the current consumed.

In large cities which are usually supplied with direct current, there are only two methods of battery charging. The most convenient of these two methods is the direct use of the house current through a suitable resistance to the battery. The efficiency of such a system is very low, however, due to the high IR drop (about 100 volts) which must take place across the resistances. Thus, when charging a 6-volt battery at a ten ampere rate from a 110 volt d. c. line, the power consumed by the resistances and dissipated as heat is 102 x 10 or 1020 watts, while that consumed by the battery is only 8 x 10 or 80 watts. Thus the efficiency of this method of charging is only eight per cent. The cost of charging a 100 ampere-hour battery is about ninety cents. The only other method of charging batteries from d. c. is by means of a motor-generator, whose efficiency is much higher. The initial cost and space oc-

TABLE I

TYPE CHARGER	TIME IN HOURS
Two-ampere tube charger	80
Five-ampere tube charger	36
Three-ampere chemical charger	55
Motor generator	12

This table shows the approximate time required to charge a fully discharged 100 ampere-hour 6-volt storage battery by means of several different types of chargers. It costs with generator approximately twenty-five cents to charge completely an entirely discharged 100-a. h. battery, in about twelve hours.

cupied by a motor-generator is generally, however, much greater, so that where considerable use of a single six-volt battery is not to be made, the ultimate value of a motor-generator is questionable.

THE VALUE OF THIS OUTFIT

FOR use on alternating current, though, where some device is necessary to convert the alternating current into at least pulsating direct current, the motor-generator offers many advantages when used with batteries of from 60 to 100 ampere-hour capacity. With larger batteries, the use of the motor-generator becomes almost essential.

The use of a motor-generator charger is not advisable with batteries of less than 60 a. h. capacity. In the recent comparative tests made by the Bureau of Standards at Washington with the different type battery chargers available for radio use, the motor-generator was found to be the most efficient.

Some of the advantages of the motor-generator are:

1. Highest efficiency
2. Quickest method of charging
3. Longest life (no bulbs, etc. to burn out)

The only disadvantages possessed by the motor-generator is its high initial cost. This is true of the complete units available in the electrical market, but it is the purpose of this paper to describe a motor-generator type charger which in many cases can be had for the mere effort of assembling it and in any case for a less financial outlay than is required for the ordinary five-ampere charger.

THE CHARGER COST TWELVE DOLLARS

THE photograph shows an exceedingly well made and efficient charger which cost less than $12. Of this, $9.90 was for the motor. It was a new $\frac{1}{6}$ h. p. self-starting split phase General Electric induction motor which turns over at 1725 r. p. m. on 110 volts 60 cycle a. c. The Westinghouse generator was obtained from a wrecked Chalmers which had come into the possession of the local garage. This charger has now been in use for more than a year, and has never had to be adjusted or tinkered with.

Excellent generators may be obtained at junk prices at any of the automobile wrecking yards. The average price is $5.00 for a guaranteed generator. It is also possible, however, to purchase second hand generators in good condition at a reasonable price at most garages and repair shops. Inquiries made at a number of local garages revealed the fact that it is quite easy to obtain a very satisfactory second hand generator from this source for less than $10. New generators cost from $17 up, depending upon the make. The points to watch in buying an old generator are:

Reason for selling
Condition of commutator
Condition of windings
Condition of bearings
(most generators have ball bearings, which, if not in good condition, may be readily replaced)

In order that the motor might also be used for other purposes it was mounted as shown in the photograph and connected to the

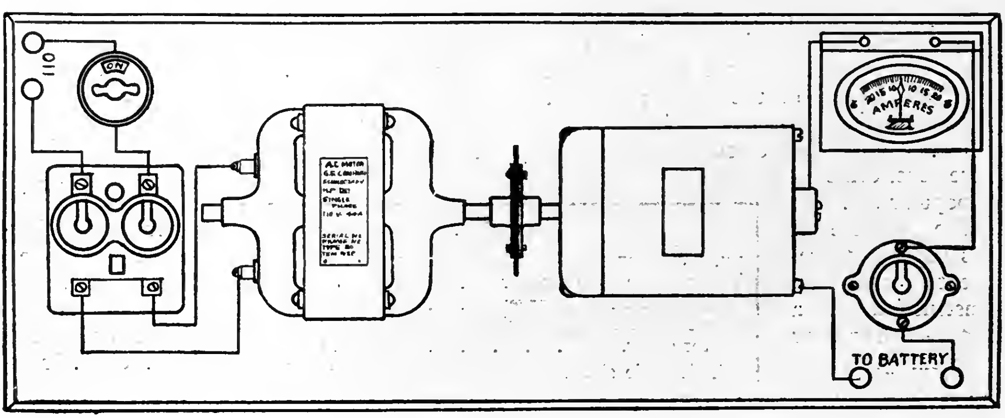


FIG. 1

A picture diagram of the charging layout. The 110-volt line is fused directly after the switch. A single fuse is also included for protection in the charging circuit

generator by a belt instead of directly with a universal joint. This also makes possible the use of different sized pulleys for obtaining different generator speeds, and thus altering the charging rate. Slots are provided in the base in order that the two shafts may be properly lined up and the belt kept tight. The base was made from a piece of 18″x 10″ x 2″ oak. The pulleys were home-made, but if a lathe is not obtainable, then they may be purchased from a dealer in second hand machinery, or they may be turned directly on their own shafts as was the case with those shown in the photograph. In order to run the generator as a motor from the storage battery for this purpose, it is merely necessary to press the cut-out contacts together. A one inch single-ply belt was used, although an automobile fan belt is also admirably adapted to the purpose.

In order to eliminate any possibility of belt trouble, especially where the motor is not to be put to any other use, (such as running a small lathe, emery wheel, etc.) the generator may be directly coupled to the motor by means of a universal joint. The universal joint (or coupling) which comes with most generators will prove ideal for this purpose. The shafts of the motor and generator should be carefully lined-up and the two units securely fastened to the base. The universal is then securely fastened in place by means of the tapered pins and Woodruff key provided for this purpose. Of course a high order of precision is not absolutely essential in this work as the flexible coupling is more than able to take care of a slight inaccuracy in alignment.

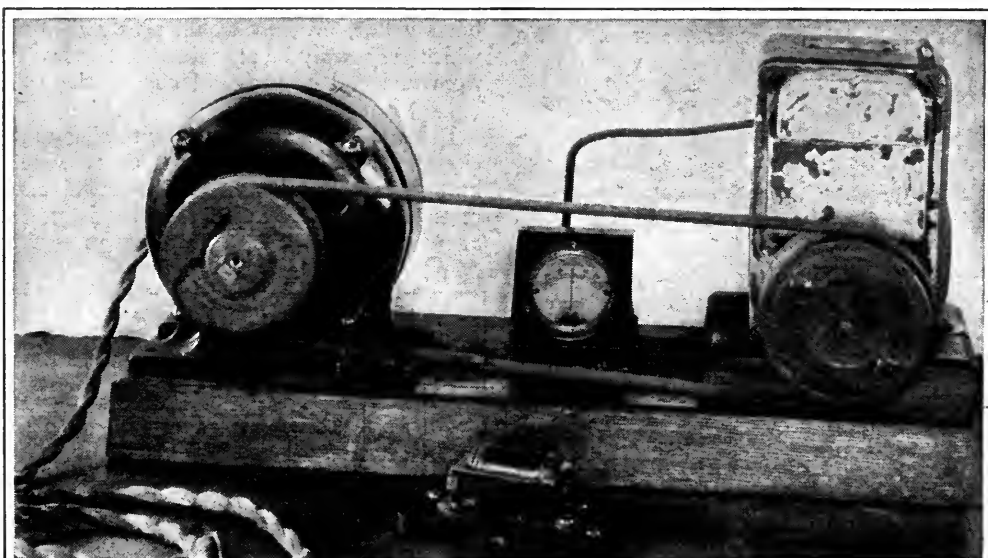
Another substitute for the belt is the chain drive. The average chain drive is slightly more expensive, more noisy, more difficult to install and must be lubricated. It will, however, make a very satisfactory drive where it is not deemed advisable, to use direct coupling.

In order to test out the efficiency of the belt drive, a revolution counter was attached to both the motor and generator and frequent checking showed that the losses due to belt slipping could easily be kept negligible.

THE PARTS AND THEIR COST

A GOOD motor-generator charger can be made entirely from new material for approximately $29, or about the same price as a five-ampere tube charger. (List price about $28). The following parts will be required:

New Ford Generator, with cut-out	$17.00
New $\frac{1}{6}$ H. P. Induction motor	9 90
Wood base	1.50
Ammeter	1.50



—Court Studio

THE COMPLETED UNIT

Containing a $\frac{1}{6}$ horsepower motor, driving an old automobile generator. The motor is at the left and the automobile generator at the right, with an ammeter between. The separate automatic cutout is shown detached. This is merely a rough model. An accompanying drawing shows a suggested base layout

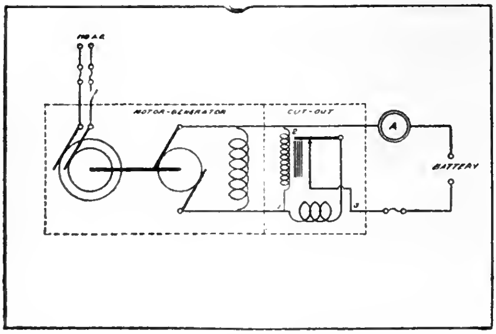


FIG. 2

A complete hook-up, showing the apparatus illustrated in the photograph. 1, 2, and 3 are connections to the cutout device shown as separate in the photograph. A is the ammeter. Note the fuses indicated in the 110-volt alternating current line

Re-built Ford generators sell for $10 at almost all Ford repair shops.

When a high grade second hand generator of the two brush type, similar to the one shown in the photograph, can be obtained in good condition, its use will result in a more efficient and flexible charger.

Ford generators deliver 11 amperes at 8.5 volts to the average six volt 100 a. h. battery when directly coupled to a 1725 r. p. m. motor. As the voltage of these generators is not readily alterable, it is advisable to use a belt drive where a lower charging rate is desired, as in the case of small capacity batteries. The Ford generator revolves in a counter-clockwise direction when viewed from the commutator end.

CARE OF MOTOR AND GENERATOR

MOST generators are entirely enclosed in metal shells which completely protect them from dust, oil, and water. The only attention they require is a few drops of oil occasionally. If a second hand generator is to be used, then it may be necessary to clean the commutator and possibly to replace the brushes. In order to get at the commutator, remove the steel band that is fastened around one end of the case. If the commutator is found to be corroded or rough, it may be easily cleaned and smoothed with No. 00 sand-paper. Never under any circumstances use emery cloth on the commutator of any motor or generator. All the small particles of copper, carbon and sand dust should then be carefully removed. The commutator should also be examined to see that none of the segments are shorted together. If a small piece of copper from one segment touches the next, it should be scraped away. Next examine the brushes to see that they make an even contact, but without pressing hard enough on the commutator to cause excessive heating and wear. The pressure on the brushes is controlled by means of small springs. If the brushes are worn to such an extent as to need replacing, then it is advisable to get just the right kind from the maker of the generator. Make-shift brushes are merely a source of continual trouble. In replacing the brushes care should be taken not to crack any of the insulating bushings which support the brush holders, as they must be well insulated from the generator frame. Extreme care must also be exercised to keep all oil and grease from the commutator and brushes.

The third or adjustable brush found on many generators may be shifted in order to change the charging rate of the generator for any given speed. When this brush is displaced in the direction in which the armature turns, the charging rate will be increased, and vice versa. The charging rate of the Westinghouse generator previously referred to (which has only two brushes) is alterable by means of the small adjusting screw on the end of the case. On some generators, such as the Ford, there is no method of altering the charging rate except by changing the speed. Under such conditions it becomes necessary to use a rheostat in the 110-volt line, cone pulleys for changing the generator speed, a rheostat in the battery line, or, best of all, a field rheostat, which may easily be placed in the line leading from one end of the field coil to the third (small) brush.

It is not necessary, however, to change the charging rate by such means every time a battery is charged, as the charge will automatically taper. Thus if charging is started at 16 amperes it will have dropped to 10 by the

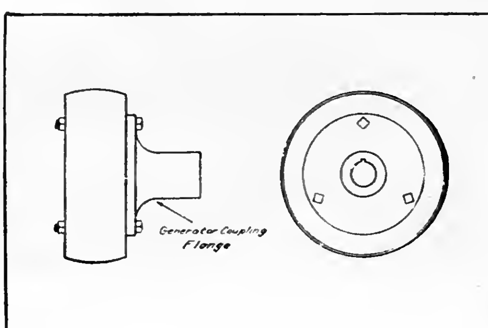


FIG. 3

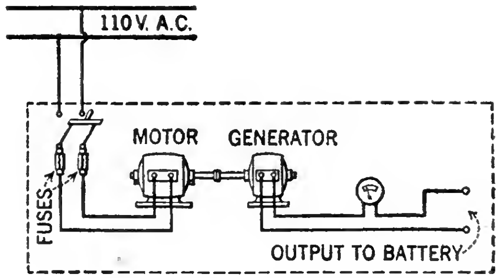
Details of the generator coupling-flange

time the battery has become nearly charged. An initial rate of 8 amperes will taper to about 4 amperes, which is, perhaps, the best all round rate at which to charge a 100 a.h. battery. Under such conditions the time required for a complete charge will be about 20 hours. Some generators will not deliver more than 18 or 20 amperes without danger of burning out the armature. The maximum safe charging rate can be ascertained from the plate on the generator.

The efficiency of the generator whose charging rate could be varied without varying the speed, was found to vary with the charging rate. This is mainly due to the rapid decrease in efficiency of a. c. motors when operated at less than the rated load. With the previously mentioned Westinghouse generator running at a constant speed of 1400 r. p. m., the maximum efficiency (30 per cent.) was obtained at 13 amperes. (Generator efficiency alone was 80 per cent.)

The ammeter shown in the illustrations is a Weston 20-0-20 but a cheaper automobile dash meter, although not necessarily accurate, will serve to show when the battery is properly connected and the approximate charging rate.

Some generators, such as the Westinghouse, have built-in cut-outs, while those that do not will require external ones. The cut-out is necessary in order to prevent the battery from discharging back into the generator in case the motor should stop when no-one is around to disconnect the battery. All low voltage wiring should be done with No. 10 or heavier wire.



The basic wiring circuit of the motor-generator unit

And now a few words about battery charging. Contrary to general opinion a high initial charging rate is not in any way injurious to a battery as long as the temperature of the electrolyte does not exceed 110° F, and the gassing is not excessive. Excessive gassing tends to loosen the active material in the battery plates, and thus shorten the life of the battery.

Unless a cut-out is being used, it will be necessary to disconnect the battery from the generator when not charging. This may be accomplished by means of a single pole knife switch.

THE FACTS ABOUT REFLEX CIRCUITS

ARE informatively and interestingly told in another article by Julian Kay in his excellent "What's In a Name?" series. Mr. Kay tells what the various types of reflex circuits are, and how they work, in addition to the general radio information which many of our readers have followed in his previous articles with much profit and interest. This article will appear in an early number.

The Listeners' Point of View

Conducted By Jennie Irene Mix

How the Radio Public Should Be Pleased

SOME day large delegations of radio listeners-in are going to march from one broadcasting station to another and the managers of each will be informed with much sternness that their own passionate fondness for the sort of music called jazz is not shared by anything like a majority of the people who buy receiving sets."

This was the opening paragraph of an editorial on radio music that appeared recently in the New York *Times*.

We can easily visualize that procession. Tens of thousands, increased town by town by other tens of thousands, growing and growing, until there are millions of them. This is no exaggeration. Protests against radio musical programs are universal.

THE GRAND PIANO

Finished in old ivory to correspond with the style of the studio at station CKAC, *La Presse*, Montreal, Canada. In front can be seen the magnetic Marconi type microphone, used exclusively by this station

Unfortunately, the people who object to having the radio monopolized by jazz are the sort of people who do not voice their objections through letters to broadcast directors. Were it otherwise, many of the stations would be so flooded with mail that all other work than reading it would necessarily cease for the time being, which would be a good thing, for that would mean at least a temporary cessation of jazz.

To make a conservative statement, more than a billion dollars are spent in this country each year for good music, meaning by this term the greatest music ever composed. This money is spent in patronage of concerts and grand opera, and for music lessons and the buying of music scores. With but few exceptions, the greatest musical artists of Europe find in America's patronage of music their chief source of income. And they are accorded this patronage year after year, from the people of big cities and of small cities, because the American public knows good music when it hears it and wants to hear as much of it as possible.

These same people are spending millions of dollars each year that their children may have musical instruction. Taking this country as a whole, the standard of such instruction is high. Even in the smallest towns may be

© Harris & Ewing

MRS. CARL CHINDBLOM
Wife of Representative Chindblom of Illinois and an outstanding figure in the musical life of Washington

found teachers who are guiding their young pupils toward an appreciation of the best in music. The day when Susie Simpkins of Simpkinsville, as her highest musical ambition, looked forward to the day when she could play "Hearts and Flowers," has long since passed. All the Susies in all the Simpkinsvilles are now playing Haydn, Mozart, Mendelssohn, and Beethoven sonatas, and the simpler pieces of Grieg and Schumann. And they like this music, like it far better than the cheap stuff of which they would grow tired if they practiced it for a week.

In the larger communities the musical instruction of the young people is so advanced, and on so high a plane in every respect, that, nowadays, a student beginning before ten has a well-developed taste for the best music long before he or she is out of the 'teens.

But it costs the parents much money to give their children such musical opportunities, and requires intelligent supervision as well.

Times without number has the editor of this department heard a mother or a father say:

"No, I will not have a radio set in my home. Under no circumstances would I permit the developing musical taste of my children to be influenced by such music as is broadcast night after night."

One man said:

"No one would think of calling me highbrow if I refused to have a mechanical contrivance in my home that for hours each day talked aloud and murdered the English language with every sentence. Why, then, should I be called highbrow if I refuse to have something in my home that, day after day, distorts and murders music? All I can say is, if this means being a highbrow, then may I live and die one!"

Another man, after hearing a so-called musical program broadcast by a commercial firm, exclaimed:

"I'll never buy one of their products! I'll bet they're just as bad as that music!"

The program had been composed wholly of jazz with numerous unspeakable saxophones predominating.

Fourteen Red Hot Mamas

CAME a woman's voice over the telephone:

"Are you the one that writes that 'Listeners' Point of View' in RADIO BROADCAST?"

"Yes."

"Well, I want to tell you that we've bought a radio set and it's perfectly awful!"

"What kind of a set have you?"

"Oh, I don't mean the set is awful. It's wonderful. We can get all the stations. But the music! Last night we tuned-in four-

THE KDKA LITTLE SYMPHONY ORCHESTRA

Victor Saudek, Conductor. Seated, left to right: Milton Lomask, Pierre De Backer, Leo Kruczek, violins; Elmer Hennig, 'cello; Raymond Bandi, viola; James Younger, 'cello; Herbert Saylor, viola; Rest Baker, violin. Standing, left to right: Stephen Konvalinka, trombone; John J. Harvey, trumpet; William Nugier, drums; Karl Haney, bass; Victor Saudek, Conductor; Stephen Miller, Jr., piano; Alvin Hauser, flute; S. Sapienza, clarinet

Thomas Coke Knight

HELEN TAYLOR, MILDRED DELNA, AND ANNA PINTO

Who have been heard from WJZ. Miss Taylor is a coloratura soprano who recently made her radio debut from this station. Miss Delna, a soprano, has been heard with pleasure by WJZ's audience. The tones of Miss Pinto's harp have pleased radio listeners at various times for more than three years

teen stations and every one announced that the orchestra would now play 'Red Hot Mama'! And everything else was just like that."

She talked for quite a time. She complained justly that she had no guide in the advance programs published in the papers as to where she could get the good music. All that the programs indicated was that at such or such an hour a musical program would be given. "And it's always such rot!" was her wail.

When Good Music Is Broadcast

OF COURSE, it isn't "always such rot." Taking the country by and large, quite a bit of good music is broadcast each week. But it is insignificant in quantity when compared with the cheap and tawdry stuff that is sent out over the air. And it is generally so mixed up on a program that contains the worst as well as the best that many people who might hear it fail to do so because they have tuned-out in disgust.

To quote again from the *Times* editorial:

"Jazz, especially when it depends much on that ghastly instrument, the saxophone, offends people with musical taste already formed, and it prevents the formation of musical taste by others, and even its votaries are cautious enough—have enough respect for their reputations with civilized people to say, 'Oh, we don't ever listen to it. We only dance to it.' But the often mentioned radio audience does not dance, at least while it is justifying its name, and there is no imaginable excuse for giving it jazz, hour after hour, every evening from nearly all the stations."

From Mr. Gordon Balch Nevin, well-known author of various books on music, a composer and organist of the First Lutheran Church at Johnstown, Pennsylvania, some comments have been received upholding the policy of this department in decrying the hodge-podge musical program so prevalent at present in broadcasting. A portion of Mr. Nevin's letter reads:

> I am not one of the class of musicians who dislike popular music, the music of the day, even jazz, for that matter. I do not adopt an up-stage attitude in regard to this class of music. In fact, there are times when, for perhaps half an hour, I find good jazz played by a real orchestra to be a mental tonic. But I do most certainly object to the very thing so often mentioned in "The Listeners' Point of View"—the haphazard and scrambled arrangement of most radio programs.
>
> I wonder if the broadcasters are not missing an opportunity to evolve the novel and unusual type of program. In my own recital work I have found the all Wagner, or American, French, or German type of program, also, to some extent, the historical or chronological type, to be very good and helpful for the listener. At least, there is a certain coördination and continuity that gets somewhere.
>
> I hope to see some competent singers giving programs, each selected from some one composer or nationality. When they do this there will be enough of us who will not spin the dial on them.

Mr. Nevin then goes on to cite an example of the mentality of some listeners-in. He was in a broadcasting station while a Bible lesson was being sent out. The instant this pro-

gram closed, some "half-wit," as he so aptly describes him, telephoned in requesting that "Hot Mama Blues" be played. "Comment is futile," he adds.

The pity of it is that, times without number, program directors accede to such requests. Why do they do it? Do they actually think that the radio audience is wholly composed of morons?

Mrs. Nobody of Podunk is giving a party. She telegraphs to some broadcasting station that they all want to hear such and such numbers. Immediately all the listeners-in, probably tens of thousands of them, are also supposed to want to hear this same trash.

Suppose you had bought a ticket for a public concert. And, suppose, instead of hearing the sort of program you expected to hear when you paid for that ticket, you were obliged either to leave the hall without having had your money's worth, or to sit there and listen to a lot of junk that this, that, or the other person in the audience took it into his head he wanted to hear. What would become of our concert programs if they were conducted in this fashion?

And what is going to become of radio programs if every Tom, Dick, and Harry can telephone or telegraph in and have the numbers he requests played or sung?

"The Public Be Pleased"—How?

"BUT we must please the public!" exclaim the broadcast directors.

That is exactly the point we are making. The public is not being pleased with radio musical programs. For the public consists of intelligent people of discriminating taste as well as of those to whom music means only jazz.

Station KSD, which is operated by the St. Louis *Post-Dispatch*, is one of the few broadcasting stations in this country that recognizes the musical cultivation of many among the radio audience. The broadcasting by this station this season of fifteen concerts by the St. Louis Symphony Orchestra is an epoch-making event in radio entertainment. These concerts are not staged simply for the radio. They are the regular subscription programs and are broadcast direct from the Odeon Theater, where all these subscription concerts are given under the direction of Rudolph Ganz.

Five of these programs have already been broadcast, and the remaining ten will be put on the air December 27, January 10, 17, 24; February 7, 14, 21, 28; March 7 and 14. The dates all come on Saturday evening. The concerts begin at 8 o'clock, Central, and 9 o'clock Eastern Standard Time.

The broadcasting of these programs is not only giving a large public opportunity to hear many among the classical symphonic works, but also to hear new works of important significance, among them Vaughn Williams's "London Symphony," the much talked-of symphony by Hanson, Igor Stravinsky's "Fireworks"—one of the most notable among modern compositions—Ernest Schelling's "Victory Ball," Honegger's "Pacific 231," and Respighi's "Three Old Dances."

One can just hear some people saying, "Oh, the public doesn't care for that highbrow stuff!"

Doesn't it? Why, then, are there now in this country fully fifty symphony orchestras that each season give programs of the best orchestral music? And why is it, then, that other cities and towns are making heroic efforts to have their own orchestras?

Why? Because of the widespread public demand for great music.

Do Listeners Want Their Programs Explained?

MR. JAMES C. MOFFET, of Louisville, Kentucky, has written to this department suggesting that radio announcers in presenting a musical program preface each number with some explanatory remarks, given in non-technical language. He believes this would help to popularize good music, and that this form of musical education can be put out better over the radio than through any other medium. He adds:

"The concentration of mind induced by listening-in on any explanation on the radio, with nothing to distract the attention of the listener, as in a public hall or concert room, would make this form of exposition peculiarly valuable. I know that I remember what I hear over the radio better than what I receive as one of a big audience at a concert or lecture."

Although it would not be advisable to preface each number on each musical program broadcast with explanatory remarks, it would undoubtedly be a constructive plan if this were done at stated intervals. There is an unlimited amount of interesting information from which to draw for such talks and still keep them within the comprehension of the layman.

Explanatory programs have indeed been tried, from time to time, by various stations.

So far as the present writer's knowledge of these experiments goes, the prefatory talks generally sounded as if being given, not by an authority on the subject, but by some one who had crammed for the occasion. The results in such a case, no matter what the subject talked about, are bound to be disappointing, to miss fire.

In order to talk about music or any musical composition in a way to hold the interest of the listener, the speaker must know a great deal more about his subject than simply the phase of which he is at the moment presenting. A broadcasting station can never successfully give educational musical programs until willing to pay some thoroughly competent specialist, who is also a good talker, to give these explanations.

All other subjects than music, when discussed over the radio, are discussed by well-known authorities on these subjects. This is as true of astronomy as it is of pugilism. But, as a rule, when anything is said about music, it seems to be considered that anybody can say it.

At present, the most conspicuous exception to this rule may be found in the series of talks on orchestral instruments being given through station KDKA by Mr. Victor Saudek.

As everybody knows who owns a radio set, Mr. Saudek is director of the KDKA Little Symphony Orchestra. But he is much more than this. His current musical work along various lines and his experiences in the past place him among the leading authorities in the country on orchestral instruments and their use.

Mr. Saudek was for many years a member of the Pittsburgh Symphony Orchestra, playing in that organization first under Victor Herbert, then for six years under Emil Paur. He is at present teacher of orchestration in the combined music departments of the University of Pittsburgh and the Carnegie Institute of Technology. He is also director of the Woodwind Ensemble at the latter institution. He has delivered many lectures on orchestral instruments for the Board of Education of the Pittsburgh public schools, and also for various colleges. In addition to his work as director of the KDKA Little Symphony, he is organizing a light opera company for this station.

In his weekly talks on orchestral instruments which are now being given at KDKA, Mr. Saudek divides the instruments into their four natural groups—the strings, the woodwind, the brass, and the percussion instruments. The history of each instrument, or co-related instruments, is briefly given, and this is followed by a clear discussion of the chief characteristics of the instrument, after which its qualities are illustrated by the playing of excerpts from that instrument's part in an accredited orchestral work.

The concluding feature of this series of talks which will continue for some twelve weeks from their inception the middle of last November, will be a concert in which the more unusual instruments, such as the woodwind group and the horn, will be used.

A very interesting feature of this concluding concert will be the coöperation of the radio audience. The instruments will be announced not by name but by number, and the audience will be asked to send in the names of the instru-

Francis Brugiere

THE MADONNA

As she appears when taking the place of the absent Nun in the Cathedral, in Morris Gest's production of "The Miracle," staged by Max Reinhardt at the Century Theatre, New York, and broadcast by WGBS (Gimbel's, New York) during this station's opening week. Lady Diana Manners is here seen in this rôle

ment corresponding to each numbered solo, or the names corresponding to the numbers of such ensemble groups as may be used.

Here, in its most instructive and delightful form, is musical education over the radio, given by a professional specialist in the subject treated. Such a broadcasting feature will go far toward wiping out memories of musical disappointments experienced after one has tuned-in.

Mr. Saudek might well make these illustrated talks on orchestral instruments an annual feature at KDKA. For there is absolutely no question as to their success.

In his work with this Little Symphony, Mr. Saudek has brought the organization to a point of excellence where it has no superior among the orchestras regularly associated with broadcasting stations. Many of the sixteen men who make up the orchestra's personnel are virtuosi, with training gained in regular symphony work. Taking the programs in the aggregate, this orchestra broadcasts much good music. One looks forward to the day when they will set aside one hour two evenings a week and give, during that hour, nothing but music worthy of being heard at a public symphony concert. If, let us say, such a program was given every Tuesday and Friday, or Monday and Thursday, or Wednesday and Saturday from eight to nine, and this was continued month after month, the audiences listening-in would be so large that the other broadcast stations might well rejoice that they could not know how they were being neglected.

Good Music That Is Popular

A PIANIST who knows from experience that radio listeners enjoy good music, is Mrs. Carl Chindblom of Washington, D. C., who has been heard a number of times through station WRC of that city.

Endowed with exceptional musical talent, Mrs. Chindblom from childhood had the advantage of training under the best masters. She is the daughter of Hjalmar Nilsson, who has directed Swedish male choruses in this country for twenty-five years and has received decorations for his musical work from the King of Sweden and the Singers' Union in Sweden, as well as in America. At the age of fourteen, Mrs. Chindblom, then Christine Nilsson—"but no relation to the famous singer," she explains—went to Stockholm where she pursued her piano studies.

Mrs. Chindblom is the wife of Representative Chindblom of Chicago, who, next March, will finish his third term as representative of the Tenth District of Illinois, and who is also a member of the Ways and Means Committee. Although corresponding secretary of the Congressional Club which is composed of wives of the members of Congress, occupied with social duties and the management of a home, Mrs. Chindblom still keeps up her musical work through taking lessons and public playing. Her cosmopolitan life has confirmed her natural faith in the people's love for good music provided they have opportunities to hear it.

"It did not occur to me," she said when speaking of her broadcasting experiences, "to play trashy music. For that matter, I could not have played it, anyway, for I have not concerned myself with such music. Why should one, when so many like to hear the best?

"And why should I think, just because I happened to be playing for an invisible instead of a visible audience,

Waters, San Francisco

COMMITTEE AND READERS

A service that is meeting with far-reaching success is broadcast daily at station KPO, San Francisco, immediately after the Naval Observatory time signals. First, the chimes you see in this picture are played, and, as chimes are always very lovely over the radio, the opening of this service immediately engages attention. There then follows a reading of the scriptures, always from those portions that are not controversial, but of a character to make universal appeal. The director of the station may be seen (in gray suit) standing in front of the chimes

White, New York

THE LAMED PIPER

(Werner Krauss), healed at the foot of the wonder-working statue of the Madonna (Lady Diana Manners) in "The Miracle"

that my listeners would want mawkish or cheap numbers? I cannot understand why any one who is accustomed to playing good music should be willing to play any other kind when broadcasting.

"One of the best received numbers I have broadcast, is the D'Albert *Suite*—the one with the *Allemande, Gavotte,* and *Musette.* It is built, you know, on classical lines, very much in the style of Bach, but with the modern touch so characteristic of D'Albert who, noted first as a great pianist, can well lay claim to being, if not equally great as a composer, one that has added much to modern piano literature.

"Another number that has also been much liked by my radio audience is the *Preludium* from Grieg's *Holberger Suite.* Then I have also broadcast a Schumann *Nocturne,* Scarlatti's popular yet very classical *Pastorale,* the Liszt arrangement of Mendelssohn's "On the Wings of Song," and the "Concert Fantasie on Swedish Folk Songs," by Emil Larsen, one of Chicago's leading musicians.

"What are my feelings when playing for an invisible radio audience? Well, it is difficult to describe them because they are not essentially different from my feelings when playing for a visible audience. But I always have the feeling that there *is* an audience out there beyond—near and far—and the absolute consciousness of this is an inspiration. And I am always on my mettle, for I know that, over the radio, every wrong note, every slightest mistake, stands out with glaring distinctness. I know this from having listened so much to others. When a number is announced with which I am familiar, I listen always in the hope of learning something from the performance, and I very often do learn something, either regarding technical execution, or interpretation, and sometimes both.

"Although I play a good deal in Washington each winter at musicales and concerts, and last winter gave a number of programs with Congressman Woodrum, the 'Singing Congressman' as we call him, the enjoyment was no greater, if as great, as that I experience when playing for radio audiences. I do not know whether this feeling I have about radio listeners is shared by others who broadcast. I only know that it is the way I feel. There is always in my mind the thought that among those listeners I cannot see may be some who are thoroughly competent to criticise, and who will know from my playing just what sort of

Aldene, New York

NATHAN ABAS AND HIS PENNSYLVANIA HOTEL CONCERT ORCHESTRA

Tri-weekly features on WJZ's programs. This is the real thing, and not a jazz orchestra, which may account for the fact that it is one of the most popular organizations now broadcasting regularly. Their Sunday evening concerts given at 7 o'clock, Eastern standard time, are especially well worth hearing

musician I am. The result is, that when before the microphone, I feel that I am playing for the most exacting yet appreciative of audiences."

Because she does not use her music as a means of livelihood, Mrs. Chindblom is not personally concerned with the question of payment for broadcasting. But she is completely in accord with the stand taken by professional musicians who depend on their music for their living, that they should be paid for radio appearances,

Praiseworthy Work of a New Broadcaster

UNSTINTED praise is due the management of WGBS [Gimbel Brothers of New York] in that they had the artistic vision to broadcast, during their opening week, Morris Gest's production of "The Miracle," which has had a long run at the Century Theater, New York, and, at this writing, is scheduled for a six weeks' run in Cleveland, Ohio, the only city outside of New York where it will be presented.

It might be thought, upon first consideration, that a performance appealing first of all to the eye could not successfully be broadcast. But "The Miracle" is an exception because the story, drawn from classic legend, is of itself so beautiful and so dramatic, and because it is given a noteworthy musical setting.

During the broadcasting of this production, Mr. Fred Eric, well-known actor and stage director, gave a graphic and sympathetic synopsis of the story as it was revealed on the stage. These descriptions were vivified by Englebert Humperdinck's music for chorus, orchestra, and organ—music of a kind all too seldom heard over the radio. Humperdinck, one of the greatest masters of orchestration among modern composers, a writer of some of the most graceful and lovely music composed during the last quarter of a century, is best known by his two fairy operas, *Hänsel und Gretel*, and *Die Königskinder*. He died a few years ago, suddenly, at Neu-Strelitz, of apoplexy. He came to this country in 1910 when *Die Königskinder* received its first production on any stage at the Metropolitan Opera house with Geraldine Farrar in the rôle of the Goose Girl. He drew largely on German folk song for the foundation of his works, using them with unexcelled finesse and effectiveness. He was a close and understanding friend of Richard Wagner and assisted him in preparations for the first production of *Parsifal* in 1880 at Bayreuth. Living a simple and unostentatious life, both as artist and as man, Humperdinck nevertheless gained world recognition during his lifetime.

Having set such a standard as the broadcasting of "The Miracle" during their opening week, it is hoped that those who are to guide the work at WGBS will live up to this standard in the future.

FROM Alice L. Nealeans, of Newport, Kentucky, comes the statement, in a letter:

"Your 'scrambled programs' raps will set makers of these 'Air Entertainments' to separating the material and keeping hours for jazz and hours for high grade music, giving certain hours to each, regularly, so that radio fans may know when to tune-in and when to tune-out."

May Miss Nealeans prove a true prophet!

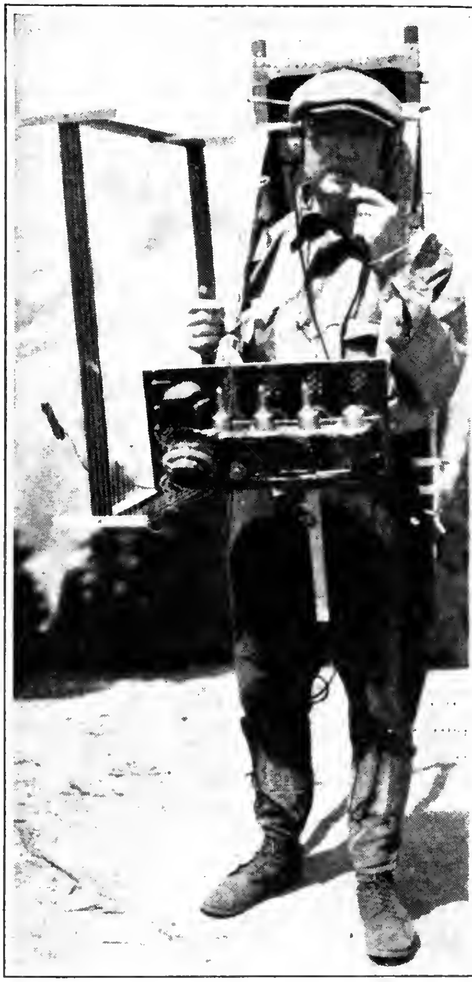
A Kit for the Radio Detective

How to Use a Sensitive, Portable Receiver to Find Interference of All Sorts—Some Radio Tests of Great Value and Interest to the Experimenter

By

ROBERT H. MARRIOTT

First President Institute of Radio Engineers



MR. MARRIOTT
With the pack loop receiver described in this article

NOT far from the point at which these paragraphs begin, the observing reader can see several photographs of a radio compass station mounted on the writer on Mount Rainier.

That is the kind of a radio compass station that can travel almost anywhere. That station is not too wide to go through doors nor too heavy for a youth. It is not too heavy for an old chap either, but of course if an old chap carries it in and around public places, it will probably be due to a lack of the dignity that usually comes with age, or due to youthful spirits, or because he wants to learn facts about interferences and the reception of radio to the extent of braving the remarks of others.

The radio compass station operator, in this case, is the means of transportation or beast of burden and, if he travels in public places, he may be referred to as a beast of burden. Somebody will surely say he is an "ass." Also, inexperienced young dogs and snappy dogs may bark at him. The wise humans and dogs will behave quite properly.

That kind of transportation for a compass station does not produce electrical disturbances to interfere with the compass readings. Also the operator is the pivot. Operator, receiver and coil turn together, which prevents changing tuning because all parts remain relatively the same.

An automobile carrying a loop cannot go up stairs and in narrow places and the ignition has to be shut off to use the radio compass. Also a coasting automobile often moves too fast to detect sources of interferences or variations in receiving ability.

Those of you who go camping in places where human transportation is the only available transportation, will recognize that thing on my back and shoulders as a special form of pack board made with braces over the shoulders instead of straps. This special pack board is just as available to carry fishing gear as to carry scientific instruments. In

another photo you can see my son wearing a regular orthodox Indian style pack board loaded with food and I am behind him with the special pack board loaded with the rest of the camp duffle, ready to go through brush and streams. Both boards are strong enough to carry fifty pounds or more. The Indian type is superior for going through brush, while the brace type can be thrown off quickly if you fall in water over your head or where you want to shed the pack quickly.

THE PACK-BOARD RADIO COMPASS

WHEN using the special pack board for radio compass work, the radio receiver is supported by the braces in front of the operator, where he can see the dials and make adjustments. Almost any kind of sensitive fairly long range receiver will do if the tubes require very little battery. The receiver in the photographs includes a regenerative detector and three stages of audio frequency, using peanut tubes that require about one volt and one fourth of an ampere each. Forty volts were used in the plate battery. That receiver was not built especially for this kind of use. It was chosen because it was convenient and light in weight.

The compass coil, as can be seen, is mounted at one side. It consists of eighteen turns of No. 23 cotton covered wire, about three eighths of an inch apart. The coil frame is of very light spruce and fitted together with screws. A folding coil would do about as well, but it might not be as strong for its weight. A clip is provided so that eight, twelve, or eighteen turns may be used. Also, the little coil in series with the loop that couples to the tickler is tapped, so altogether a range of from 200 to about 1000 meters can be covered in receiving, with the tube oscillating. An oscillating tube is sometimes better for picking up disturbances.

A Radio Set on Your Head

Can easily be very valuable, while at the same time, subjecting its bearer to a certain amount of ridicule. Mr. Marriott's interesting article tells how he built up a simple portable receiver, using dry cell tubes and a loop which he mounted on a pack board and used to trace interference from power lines, radiating receivers, and improperly operating domestic electrical devices. Since this magazine published a series of articles on "Man-Made Static" by A. F. Van Dyck in March, April, and May, 1924, interest in tracing and reducing unnecessary interference from these sources has grown very greatly. Other radio periodicals have since taken up the cause, and the general receiving situation is sure to be much improved, for power companies and even some of the thoughtless individuals are almost always willing to do all they can to reduce interference of all sorts, when it is brought to their attention. Local dealers can plot radio maps of their territories with a set of this kind, and radio club members wishing to perform public service can well take up this sort of thing themselves.—THE EDITOR.

The batteries are carried on the back on the pack board surface. Other things may be carried on the pack board at the same time. I sometimes carry such things as electrical measuring instruments on it. In another photograph is shown the board and some voltage measuring equipment that I used on Mount Rainier. I used them to find static potentials. They are not part of the compass equipment. In traveling through brush the coil frame and receiver can be removed from the side and from the braces and packed on the back. For carrying the outfit as baggage on an automobile or in a train everything is packed on the front of the board between the braces. Blankets and clothes serve for packing material, and a tarpaulin serves for the cover of the package.

A little khaki cloth cover not shown in the photo, fits over the receiver in front and another piece of khaki over the back for damp weather. All of the wood used, which was spruce, and the khaki are waterproofed by wetting them with gasoline in which paraffine has been dissolved. The gasoline evaporates and leaves the paraffine in the pores of the wood and cloth. Waterproofing the strips that support the coil wires is necessary. Spruce is one of the best woods because it is strong for its weight, but almost any available wood will do.

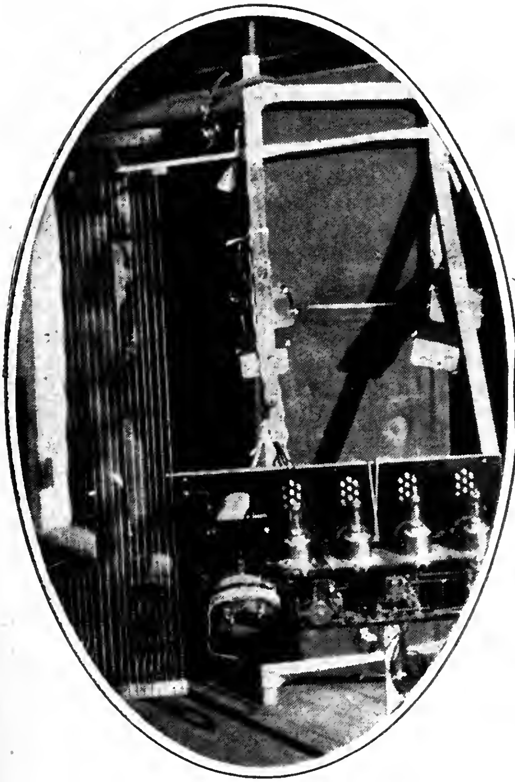
WHAT GOOD SAMARITANS CAN DO WITH THIS SET

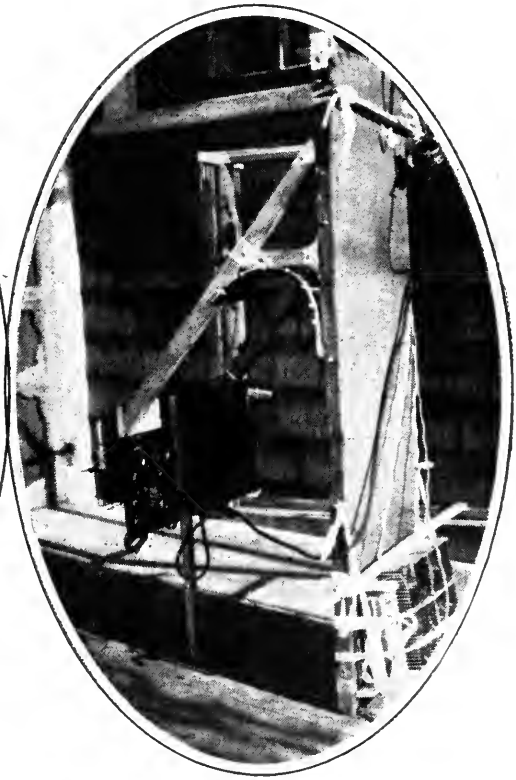
WHY have I told you about this and why am I going to say more about it farther along in the article? Because lots of people can build such arrangements as good as this or better and use them to find causes of interference, and otherwise to develop radio. Having found the causes of interference, those causes can be eliminated through the arts of diplomacy and electricity,

and the reception of broadcasts will be improved. Cutting out interference is one of the most important things in improving local receiving. One reason why a lot of interference is not cut out is because enough people do not know what the causes are. With such arrangements as this they can find the causes.

men who would not use glittering words to attract fame or money and who, therefore, attracted little or no attention.

Another way in which radio was advanced by getting more people interested in its development was through the United States amateurs. They made radio an indoor sport.





A CLOSE-UP OF THE RADIO COMPASS RECEIVER
Showing how a simple receiving set, which can be operated on a loop can be mounted on the loop frame, which carries the dry cells to run the set

The advancing of an art and science and the correction of evils depends very largely on how many people learn the facts. For example, the apparatus for radio was invented and the idea of using it for communication was conceived and published long before Marconi made his developments. But Marconi or his associates made a lot of noise about it and that interested a lot of people who investigated the facts and started developing radio.

In their publicity, to advertise Marconi and to raise money, they brought to light information and possibilities that had previously been quietly discussed orally and in print by conservative professors and old

Still another way was the Institute of Radio Engineers which was founded and devoted entirely to disseminating information for the advancement of the radio science and art. Scientific and popular publications played a part in all those ways.

LOCAL RADIO DETECTIVES

NOW that radio receivers are located practically everywhere, there are too many possible sources of interference to cover the interference subject by articles stating where interferences may be found. Another kind of education is necessary. We have got to train a lot of local disturbance finders. Some local radio detectives with radio compasses

are needed to do the finding and spreading of information.

When broadcasting first started, the uninitiated blamed all interference on amateurs and static. Now in the summer time a great deal of interference is blamed on natural static that comes from defective electric lighting and power circuits. Also, winter and summer, some one short range notorious interference is blamed for what other local interferences do. A chap's own bed warmer may be causing the interference that he blames on the Blank electric light company.

To stop interferences, first, find the interference producer; second, use your best influence to have that interference cease. Power companies are glad, usually, to do their share. Individuals are almost always reasonable about such matters, once the true situation has been presented to them.

Those who take the trouble to do this radio investigating will find it decidedly interesting. They will do not a little to advance the radio art in their locality. Especially will they advance the art, if they tell others how they do it and the results they get.

ON MOUNT RANIER

With the pack set. One attachment for the receiver allows the strength of static discharge to be measured

There is a tendency to expect the Radio Inspectors of the Department of Commerce to find all interferences and correct them. The trouble with that idea is that there are not enough such inspectors and no Congress is going to appropriate enough money to get enough inspectors. All of the present inspectors together could not take care of the interferences in New York, and there are a lot of folks and territory west of Hoboken. If you find the interference and it is something the inspectors have jurisdiction over, they will take action.

A radio compass station made up in the form of a pack is much easier to carry than a suit case arrangement, and it leaves the hands free. One can carry about fifty pounds on a pack board as easily as one can carry twenty pounds in a suit case. And a pack board radio compass, as shown in the photos, weighs only about twenty-five pounds. By using a lighter receiver and smaller batteries, that can be reduced to ten pounds. By going to extremes and using radio-frequency amplification only it could be reduced to five pounds or less. Also all the equipment could be included in one package.

HOW THE PORTABLE COMPASS IS MOUNTED

IN THE accompanying photographs you can see the pack board radio compass standing alone. The back frame is of one inch by one inch spruce and consists of two uprights and a cross piece at the top and bottom fastened by dowel pins and stiffened by sheet aluminum bent around the joints and held by screws. Khaki cloth is stretched tightly over the frame and tacked fast. Stiff brass hooks in the frame serve to allow packing cords to be fastened to them. A light stick from the bar holding the receiver serves as a leg so the pack board will stand alone when the receiver is in place. Two pieces of sheet aluminum with felt on the under side are attached to the front braces and back by single screws so the aluminum tilts slightly to conform to the slope of the shoulders.

One way to put on the device is to set the pack board on the edge of a table and duck under one of the shoulder pads and rise up. Another way is to stand to one side of the pack board, say the right side, and place the left hand under the left pad and the right under the right pad and raise the pack up

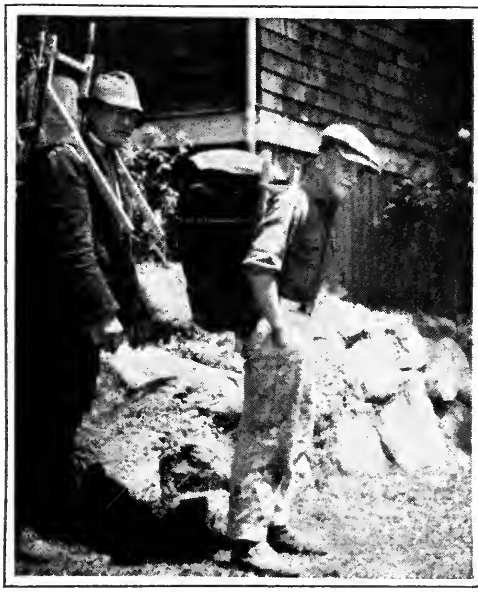
and over the head and then let it down upon the shoulders.

You can probably design a better looking outfit and undoubtedly you can provide a better looking operator, packer, or beast of burden, whatever you want to call this photographed biped.

WAYS AND MEANS OF USING THIS "DETECTOR"

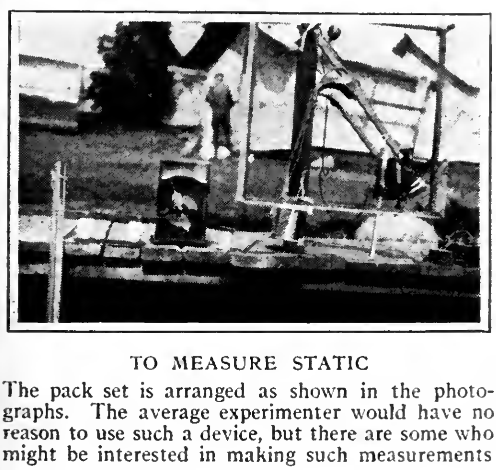
TO FIND the cause of a disturbance, put the pack board compass on, turn on the filament battery and tune-in the disturbance with the detector oscillating, if tuning is necessary. Then turn around until the disturbance is loudest and then till it is weakest or out. Those two positions should be at right angles and the disturbance should be in the direction of the wires in the compass coil when the disturbance is loudest, that is it should be either in front or back of you, providing it is from some place some distance away and there are no conductors in your immediate neighborhood. Then walk forward until the disturbance gets weaker or stronger. If it gets weaker, turn around again and if the direction of the wires is the same for maximum disturbance, walk in the opposite direction. If everything is ideal for compass work, you probably will walk right up to the cause of the disturbance.

If the interference comes from a neighbor with a regenerative detector and you set your radio compass so it oscillates, you probably will be able to follow the squeal right up to the neighbor's house. Then if you "squeal on" or "tell on" him to the other broadcast receiving neighbors they will probably join with you for a persuasive conference with the interfering neighbor. Of course if he is a stubborn Scotchman you may have to call on the Presbyterian preacher for aid. If he is a dealer in stubborn water called "Scotch," boycott him. If you have a drop of Scotch in your blood, please forget this. If your drop of Scotch is in a bottle, offer it to your interfering neighbor.



THE RADIO PACK SET READY FOR ACTION

Mr. Marriott and his son, near their home in Bremerton, Washington, ready for a journey of test and experiment with the loop receiver which the author uses for searching out interference from power lines, imperfect household electrical devices, and other sources



TO MEASURE STATIC

The pack set is arranged as shown in the photographs. The average experimenter would have no reason to use such a device, but there are some who might be interested in making such measurements

If the disturbance is caused by the lighting or power circuits of the public service company that you all are buying service from, the correction should be easy. Some of the power companies who have high voltage lines want to know when people hear such disturbances on their lines because such noises may mean leaking insulation which will break down some time and shut down their service.

Some of the present interfering apparatus was made or is owned by the General Electric, Westinghouse, Western Electric, and Bell Telephone companies. Those companies are also interested in broadcasting, therefore they should naturally want to prevent interference from their machines and devices, and want to know what you find.

There are a lot of effects that may make the spotting of the source difficult which, if you are not in a hurry to find a particular source, are very interesting.

If the disturbance is carried by a wire line

overhead or underground, the disturbance will be loudest when the horizontal wires are parallel to it, and the disturbance may follow the line for a considerable distance.

WHAT TO LOOK FOR IN TESTING

IF YOU have a large mass of metal in the house like a large furnace, all broadcasts and all disturbances may be loudest when the coil is pointing toward the furnace no matter which side of the furnace you may be on. That is providing you are alongside the furnace. You may get the same result from a tall iron structure or a wire coming down a tall pole.

If there are wire lines running along one side of your lot you may get a broadcast station on the other side and not at all or in a different direction on the wire line side. Generally speaking any conductor you pass close to will produce a change in apparent direction or in volume. Another interesting thing is that to get zero sound in finding directions the coil must be tilted sometimes. This is done by leaning over sidewise.

THE TESTER
May use telephones for reception, as Mr. Marriott does here, but one who wished to use a small loud speaker could create considerable interest

If you live in a part of the United States where summer thunder storms are common occurrences, it will be interesting to pick up their directions and follow them around, away, or over. When they are overhead or all of them are far away in several localities, the static will probably seem to come equally strong from all directions.

The pack board radio compass is a good device for comparing the receiving characteristics of different localities because you have the same apparatus to use in all the places instead of a different antenna and different ground connection in each place. For example: I used it at Bremerton, Washington on Puget Sound and then went up on Mount Rainier and concluded that the strength of broadcasts from KGO at Oakland was about five to ten times as strong at Bremerton than I found them in Paradise Valley on Mount Rainier.

Not only is the pack board radio compass useful for broadcast listeners and amateurs to enable them to divest their neighborhoods of interferences and to learn about radio but it is useful for merchants to learn of interferences and to chart their city and sales territory, marking the localities where receiving conditions are good, bad, and indifferent. Also if they want to have some fun and possibly make some sales they can put a light loud speaker on the pack board and tune-in broadcasts, for others to hear in passing.

PERSONAL EXPERIENCE

ONE evening, recently, I was out with the pack set checking up on the absorbing and direction changing effect of some wire lines. Going around the block I live in about dusk, I passed the Kitsap Inn. I noticed a woman on the porch, but not being so young as most radio engineers I was more interested in radio effects and did not pay any attention to her. I do not know whether she was a new comer to the neighborhood or whether she was peeved by my inattention. Anyhow she telephoned in to the Bremerton Police Department that there was a crazy man going around with a radio set on his head.

A few minutes later, a mechanic who was ambitious to become a sleuth, came along and paid attention to the lady on the porch and being informed of my conduct followed me at a safe distance.

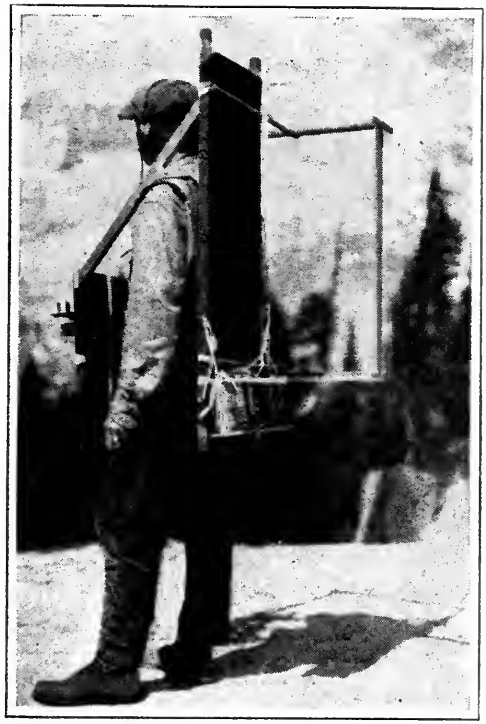
This man with the positive sleuth bias seemed to believe that I was carrying a diabolic ray apparatus which I was trying to train on the Navy Yard which is about a mile

and a quarter long. At any rate, something like that was telephoned to the Bremerton Police about the time I was passing across the street that separates Bremerton from Charleston.

After the first alarm, the Bremerton police came to look for me, after the second alarm a Charleston policeman was added to the posse. Not finding me they called out the sheriff. The neighborhood afterward told me that police were seen searching even behind garbage cans. I don't know whether any of them looked in a garbage can or not. This went on for about two hours and in the meantime I went home and set my pack compass on a table along side of a tuned antenna wire, plugged in the loud speaker and sat down.

A little later an automobile full of men pulled up just below my house on the wrong side of the street and made so much noise that I thought they were full and went out on the porch and sat down on the steps to pet the dog and watch the men. About that time one of them said, "There is a fellow sitting on the porch of that house, maybe he knows something about it." Whereupon he came over and asked me if I had seen a fellow going around with a radio set on his head. I said, No, but that I had been going around with one on my back shortly before. Then he started in to ask questions about like most people ask when they meet me wearing the pack compass.

Others came up until there were eight or nine of them and the questions seemed rather unusual, which caused me to ask why all the delegation and so much interest. I didn't know they were police because they were in plain clothes. Then they told me the whole story and I invited them in and let them listen to concerts. Altogether we had a very enjoyable evening. They told my friend McCall, the mayor, and Mac told the newspaper reporters and I don't expect ever to hear the last of it.



GOOD RECEPTION AREAS

May easily be charted with a device similar to this. Local radio dealers could send several men out with a pack set and quickly make a dependable map of their territory. A direction-finding loop set used in an automobile is not always satisfactory because the interference produced by the ignition is usually quite bothersome

"THE MAN WHO KNEW ALL ABOUT RADIO"

IS THE title of a quite amusing story by William H. Cary, Jr. Many radio folk will recognize their own portrait, perhaps, in Mr. Cary's word-mirror. It will be a feature of a coming number of RADIO BROADCAST.

© Underwood & Underwood

A BROADCASTING STUDIO WITH A PLATE GLASS WINDOW

The studio of WJZ–WJY in New York was recently moved down to the display windows of the Aeolian Building so that passing crowds might see just how broadcasting was carried on. Amplifiers were installed so that the watching crowd could hear as well as see what was going on

THE MARCH OF RADIO

By J. H. Morecroft

Past President, Institute of Radio Engineers

What Has Happened to Important Radio Patents

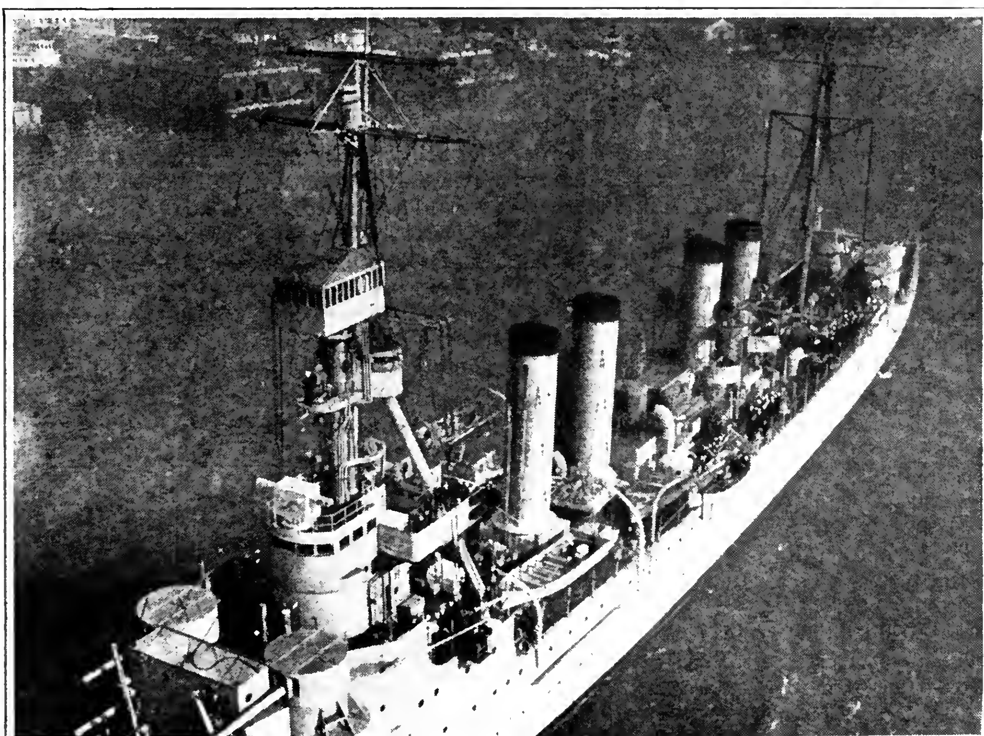
RADIO certainly has proved a boon to those who reap their livelihood by getting manufacturers into and out of legal entanglements. Patents, by the thousands, on all phases of the radio art, have been granted or applied for, and it is doubtful that a single piece of radio apparatus could be manufactured in such quantity as to bring in worthwhile returns without some dozen attorneys being able to arrange damage suits on some count or other. Some men whose names stand reasonably high in the estimation of the lay public have adopted what may be termed "steam-roller" methods of patenting radio devices. Hiring one or more attorneys, they draw up claims for anything they can conceive of whether they have made it work or not. Such men expect to make money on the "nuisance value" of their patents. We recollect seeing one man's name so often in the patent office records that he certainly must have at least 200 patents, possibly more. Such a man is trying to use the radio art purely as a money-making proposition. It is questionable if a single really original valuable contribution will be found in his whole pile of patents.

With a few such men in the game, and a

few hundred others who are more conservative in the amount of work they turn in to the patent office clerks, it is small wonder that we continually hear of patent suits. During the past month, several very important suits were either started or decided, temporarily. We say temporarily, because apparently no one but a lawyer, familiar with the various successive processes by which a suit can be continued, knows when a question is decided and when it is not.

Through various transfers of patent rights, some exclusive and some not, the Radio Corporation of America attorneys were of the opinion that they could hold the De Forest Company to carry out sales according to their desires and policies, that is, the R. C. A. could tell the De Forest Company where and how they must stick these little tags we have all seen so many times telling us that these devices are "sold for amateur and experimental use only." Early in 1923 the R. C. A. did obtain an injunction against the De Forest Company under which the selling policies of the De Forest Company were controlled by R. C. A. After thoroughly reviewing the case, vice-chancellor V. M. Lewis of Trenton, New Jersey has just handed down a decision which frees the De Forest Company from the restraining hand of the Radio Corporation. The legal arguments used are too intricate for a layman of our calibre to follow, but agreements between the De Forest Company and Western Electric Company; and then between the latter company and the American Telephone and Telegraph Company; and then with the Radio Corporation sometimes "for pay" and sometimes not, apparently convinced Chancellor Lewis that De Forest should be allowed to be free to compete with the Radio Corporation in the sale of tubes and apparatus.

In another suit, a small firm selling a few parts for a super-heterodyne has been sued by the Radio Corporation for infringement. The expert for the R. C. A. claimed that the five or more pieces collected in a box constituted the makings of a "super," although we had previously been informed that there were more than 4000 parts in the super as



THE NEW U.S.S "MARBLEHEAD"

The newest of the Navy's cruisers. The extensive use every naval vessel makes of radio is partially shown by the elaborate antenna installation aboard the *Marblehead*. This photograph was taken in the East River, New York

JACK BINNS AND HANS LADWIG

Meeting at New York shortly after the transatlantic flight of the ZR-3 was concluded. Ladwig was radio operator aboard the Zeppelin and Binns is famous as the first wireless operator to take part in a rescue at sea

constructed by the Radio Corporation and that, according to Armstrong himself, even though we were furnished with a diagram of connections and given the actual constants of the various coils, condensers, resistances, and what not, none of us could build a superheterodyne that would work. It seems that one's ideas as to what constitute a superheterodyne depends upon what one wants to prove.

During the War, someone thought of using an antenna under water as a receiver of radio signals. Under-water antennas were used to some extent for reception during the War. The principal use of such a device, however, is evidently on a submarine which needs to get radio signals when she is submerged. Dr. J. H. Rogers applied for a patent on a submerged antenna as did other inventors, some of them in government employ at the Bureau of Standards. The specific type of submarine antenna described by Dr. Rogers in his patent was an insulated wire connected to the bow of the submarine, running to the conning tower, down through the receiving apparatus, back to the conning tower. and thence to the stern of the submarine where it was attached. The hull of the submarine thus constituted a part of a one-turn loop antenna. Messrs. Willoughby and Lowell of the Bureau of Standards tried to have Dr. Rogers's patent annulled on the ground that they were the real inventors, but the Court of Appeals of the District of Columbia has, after five years litigation, declared Dr. Rogers the real inventor.

The De Forest Company has started suit against the Government to recover damages for the use of three-electrode tubes purchased for the government through the General Electric Company and others. Apparently, the De Forest attorneys think there is a possibility of showing that the General Electric Company had no legal right to sell tubes to the Government. Two million dollars is named by the De Forest Company as its estimate of the damages suffered.

Now, Attorney-General Stone has just handed down a decision which will probably prove to be extremely valuable to some of the American radio manufacturers. Some of the German patents seized by our government during the War may now be leased by the navy to American manufacturers. The Attorney-General held that there appeared to be no inhibition against the issuance of non-exclusive licenses to manufacture under the patent, but that the patent could not be sold. Use of the patents seized by the Government, several hundred in number, has heretofore been denied. Among the patents so leased is one of Schloemilch and Van Bronck covering the reflexing of radio circuits. We shall probably see a lot more reflex sets on the market in the next year or two, unless the alternating current tube should appear on the market within that time. Reflexing is a scheme for saving maintenance cost, but when an alternating current tube is available, the maintenance of a set will fall so low that the use of reflexing will not then be as general as it is now.

Radio Helps the Air Pioneers

LAST month we called attention to the help radio nowadays extends to the Arctic explorer. Now, the explorer, instead of disappearing from the face of the earth for a year or two is in daily communication with those of us who prefer the humdrum life in a more equable climate.

As we read of the transatlantic flight of the *ZR-3*, we couldn't help but think of how modestly and almost unheeded radio was making possible the record-breaking trip. A dirigible like the *ZR-3* hasn't a great deal of fuel reserve and can make only about 70 miles an hour without excessive gasoline

consumption. If she meets a head wind of much strength, she would actually be almost standing still, and a day or two of such standing still with full fuel consumption would probably spell disaster for the trip.

The *ZR*-3 however, ran no chance of getting into such difficulty; she was constantly in radio touch with one continent or the other, and with dozens of ships in various parts of the ocean, to give her weather reports, and so was able to lay her course to avoid bad weather conditions. This feat without radio, would have been entirely impossible. We can expect radio to play a rôle of ever increasing importance in pioneering of the kind our new dirigible accomplished.

What "Low Loss" Means

THE progress in any art is necessarily made in a series of steps, an improvement of existing methods here, a new idea and invention there, and perhaps improvement in material and design of apparatus elsewhere. The change of communication scheme from code signals to the spoken word at one step increased the possible users of radio from hundreds to hundreds of thousands. The advent of the inventions of De Forest, Armstrong, Heising and others increased the range of the broadcast channels from tens of miles to thousands of miles. The increase in efficiency of apparatus brought about by the thoroughgoing methods of the research engineers of the large electrical companies, and other smaller ones, such as the General Radio Company, has given us more reliable sets, easier to adjust and operate, consuming less and less battery power.

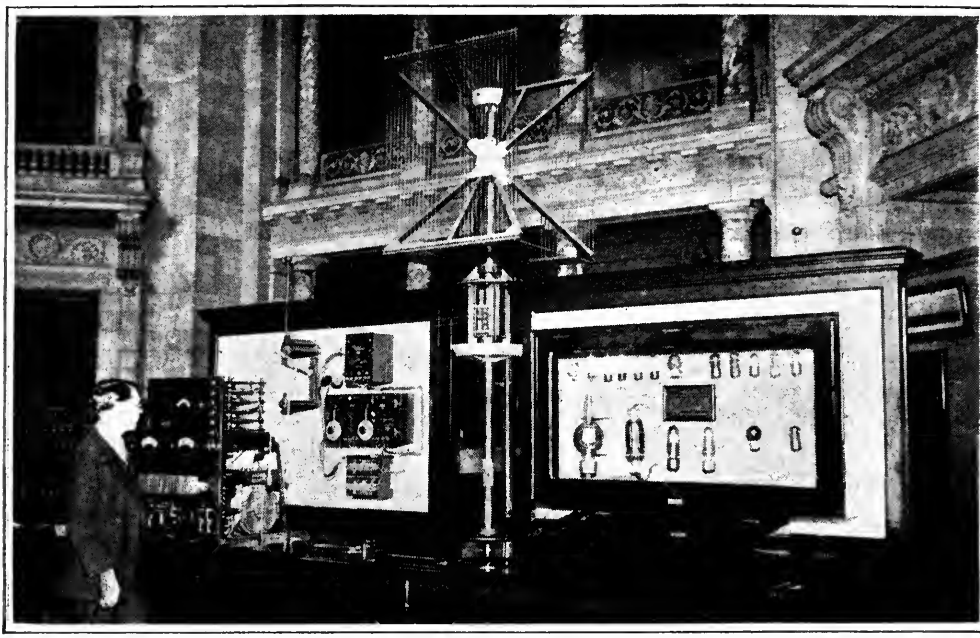
In the latter class of radio progress we have had such ideas as the unicontrol, the dry battery tube, the non-radiating set, etc., successively holding the stage in technical discussion and advertising. Of late the "Low Loss Condenser" has been the slogan of dozens of manufacturers regardless actually of whether the losses of their condensers were low or not. It seems likely that many of the "Low Loss" advertisements are based on conjecture rather than fact.

So much has the low loss idea been emphasized lately by radio manufacturers that it is likely the non-technical broadcast listener has, by the sheer repetition of this attractive phrase, become convinced that extremely low losses in a condenser are essential to satisfactory operation of his set. A condenser having a phase angle difference of one minute is thought to be twice as good as one having two minutes of angle. We have tested many of the better class variable condensers and do find that some of them have only one-half or one-third the losses of others, but this fact, striking as it may seem, should have but little consideration in the choice of a condenser. The operation of a radio set depends on many other items than the tuning condenser. Some of these are the losses in the coil with which a condenser is always associated. Now the losses in the average coil are about fifty times as much as the losses in the average good condenser. So small, in fact, are the condenser losses compared to coil losses that when any one of a dozen of the better class tuning condensers is substituted for another, no appreciable difference in the behavior of the set is discernible, even with reasonably good measuring instruments.

The lower losses a condenser has, the better it is, judged on this item alone, but the questions of permanence of adjustment, reliability of contacts, smoothness of control, etc. should be considered by the condenser pur-

MUCH EASIER THAN ORGAN GRINDING

Is the life of travelling radio music man in Germany. A number of enterprising Teutons have equipped themselves with loop receivers and a loud speaker and go about the cities vending music. The state of the musician's uniform seems to indicate that the business is reasonably profitable



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RADIO IN THE WASHINGTON NATIONAL MUSEUM

A corner of this new museum is devoted to radio. The display at the left has a complete submarine installation. A half-kilowatt quenched spark transmitter, complete with its motor generator is directly in front of the figure. Mounted on the white panel is a lightning switch and a Navy type receiver. The other displays are the standard Navy radio compass loop, and a progressive exhibit of vacuum tubes from the early De Forest audion at the left to the modern transmitting tubes below

chaser of at least as much importance as the losses.

The Meaning of Super-Power

ESPECIALLY since the recent Hoover conference, has there been much talk of super-power broadcasting stations. The word super-power station is not used in the sense that ordinary stations will be blanketed by its outpouring of radio energy, but rather that sufficient power will be sent out from the station so that static and other interfering signals will sink into insignificance when compared with the station's signals. Of course this is true now for even a 500-watt station, in respect to those listeners who are only a few miles distant from it, but evidently those who contemplate super-power stations believe that their signals will be clear and distinct for all listeners within, perhaps, a 300 mile radius. At present, this range is obtained by the present stations only with much extraneous noise. By sending out ten to fifty times as much power, the signals will reach out hundreds of miles before they drop in strength below that of competing electrical disturbances.

Many listeners are opposed to the idea of these high-powered stations, but we believe such stations are destined to come in the normal march of radio. Just as our stations went from 50 watts to 500 watts, they will go from 500 to 10,000 watts, and for the same reason, namely, to give more satisfactory communication to a larger number of people. Those who live near these coming super-power stations will, of course, be subject to more interference than are neighbors of the present stations, but the convenience of the few can never be allowed to impede a movement which is in the interest of the many. To give as little trouble as possible, the high-powered stations must be situated several miles from a large city. They will be controlled from the city studio by wire connection.

Better programs and better technical operation will come with the larger stations, and these spell progress for the broadcast art. The licenses issued to such stations will, of course, be provisional only, so that if a large share of the radio audience find the super-power idea objectionable, a return to the present low-powered stations may be readily brought about.

Antennas Are Not a Lightning Menace

WHEN radio receiving first started on its phenomenal career of popularity, many of the more cautious pseudo-scientists predicted a corresponding increase in the number of fires started by lightning. These bootless prophets averred that the radio antenna would serve as a convenient channel for the lightning bolt to enter the home. We dared to combat this view, for we thought that the increase in lightning hazard would be almost nothing, because of the general disposition of the ordinary receiving antenna.

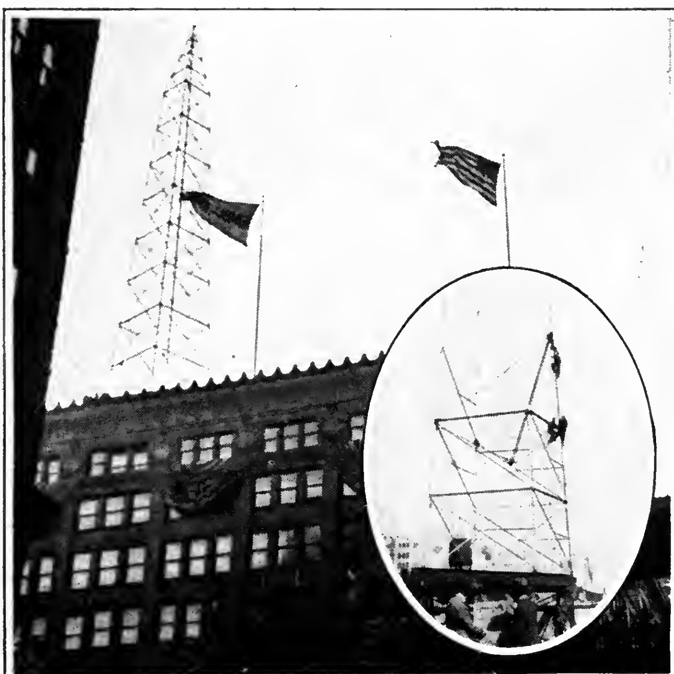
A recent bulletin of the Bureau of Standards confirms our original opinion. Whereas the radio antenna cannot be regarded as a very efficiently installed lightning rod, it need not be considered as an inviter of lightning, either. The Bureau puts an antenna in the same category, insofar as danger from lightning is concerned, as rain gutters, downleads, wire clothes lines, and metal roofs. This should be useful information for the insurance companies which have frequently in the past regarded the radio receiving set as an increased lightning risk.

Municipal Broadcasting Stations

A MUNICIPAL station such as WNYC in New York City is a very questionable benefit to those citizens whose tax contributions pay for its erection and maintenance. Especially is this true when the calibre of the municipal office holders is as low as is the case even in many of our largest cities.

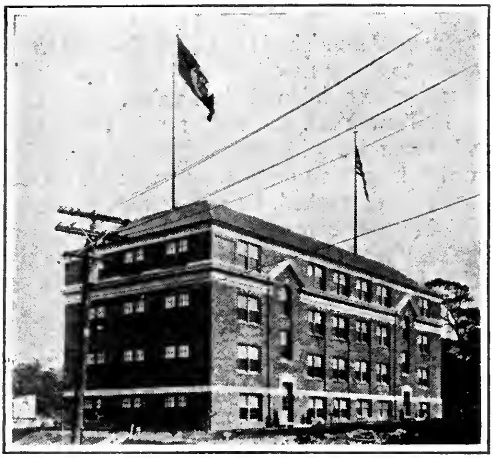
Evidently a municipal station must be largely under the thumb of the mayor or his appointees. It may be used for propaganda of the most biased sort, for unanswerable attacks on those servants of the public who happen to be of political faith different from that of the city's temporary ruler. Is this use of a city-owned station to be permitted? New York's is probably the most influential municipal station, so that it is worth while to study its operations, with the idea of forming an opinion of their value.

In New York the mayor uses the station whenever he will, speaking on any subject which he cares to select. In case his policies are being attacked, he can at once prepare a brief (or pay someone else to prepare one that he may read) showing that he is "supporting the interests of the people," whereas all others represent the "interests" and are seeking to rob the public. If his opponents want to combat his, perhaps, unreliable statements, they may do so through the city's radio station, but their remarks must be written, they must stick to their written notes, and these must be sent to the mayor's office for censoring before the speech is delivered! Others must stick exactly to the material which has been thus censored, whereas if the mayor himself is scheduled to speak on the city's budget, for example, he may forget all about the budget and spend his time vilifying some public servant who has dared to question the soundness of some of his doctrines. Surely here is a situation in the broadcasting field



STATION WGBS, NEW YORK

Recently put on the air. This station is a companion to WIP, operated by the same firm at Philadelphia. The insert shows one of the towers in the process of construction



FOR RADIO RESEARCH

This entire building, recently erected by the Radio Corporation of America in New York City, houses the technical and test staff of the organization, under the leadership of Dr. Alfred N. Goldsmith, chief broadcast engineer

which should be heralded from the housetops, so that stations of this sort may send out their messages to receivers which are all tuned to some other channel.

Is this condition morally and legally sound? Broadcasting has been put in the same class as newspapers, insofar as responsibility to the public is concerned. Is a mayor privileged to run a paper, of which he is the censor, to espouse the virtues of his régime? Certainly, it is done in many cases. But here is a different question. Is a mayor privileged to spend the city's money, collected equally from his followers and from those differing with his ideas, to purchase a newspaper for his own use? Isn't that what this municipal broadcasting station amounts to?

More ARA Public Service

THE American Radio Association is still carrying on its good work. Instead of making vague complaints about interference and other troubles, it picks out a definite point of attack and makes admirable constructive criticism. Instead of writing reams about the decrements of spark stations and the impossibility of tuning-out such signals, a letter is sent to the Postmaster-General stating that a Postal mail-boat, doing very heavy radio traffic around New York harbor, is using an antiquated spark system which is seriously interfering with broadcasting channels. Their complaint says further, "if the Post Office Department cannot afford to provide a modern transmitting apparatus for this mail-boat, several broadcast listeners stand ready to contribute to a fund to purchase the equipment and thus save the programs from the bombarding interference caused by this obsolete transmitter."

What is Happening on Short Waves

AS SOON as short-wave channels had been shown feasible for distances much greater than was ordinarily thought possible for them, all the commercial companies started experimentation in this field, and to-day a large number of stations are carrying on such work. The Radio Corporation station at Tuckerton, designed primarily for transatlantic work, with a 15,900 meter wavelength, has had its license changed so that it can use in addition 103, 100, 97, and 93 meters. KDKA is carrying on its pioneer work in this field and WGY has several short waves in use, one as low as 15 meters. POZ in Germany and UFT in France have been talking to Argentina (LPZ) on 77 meters. Two Italian stations, IDO and IHT, have been working with each other on 106 and 117 meters. The Navy reports that successful experiments have been conducted with wavelengths as low as 54 meters. It will be remembered that Marconi recently sent a 92-meter wave from Poldhu, England to Buenos Aires with a small fraction of the power ordinarily used to span a 6000 mile separation. In these tests he used Hertz's scheme of parabolic reflectors.

From the calibre of the experimenters now working in this field we can soon expect to have reliable data on short wave channels, how much fading occurs compared to longer waves, whether short period fading is sufficiently aggravated to make these frequencies of thousands of kilocycles unsuitable for telephone channels or not, and other information of equal importance.

Recent Distance Records

AS THE winter months approached, the distance-breaking contest started in earnest. Not only is the absorption of the radio signal much less in winter time than in summer, but, of far greater importance, the noises from static disturbances are only a small fraction of the summer-time values. The latter effect is undoubtedly the one which accounts for the long-distance communication records in winter time.

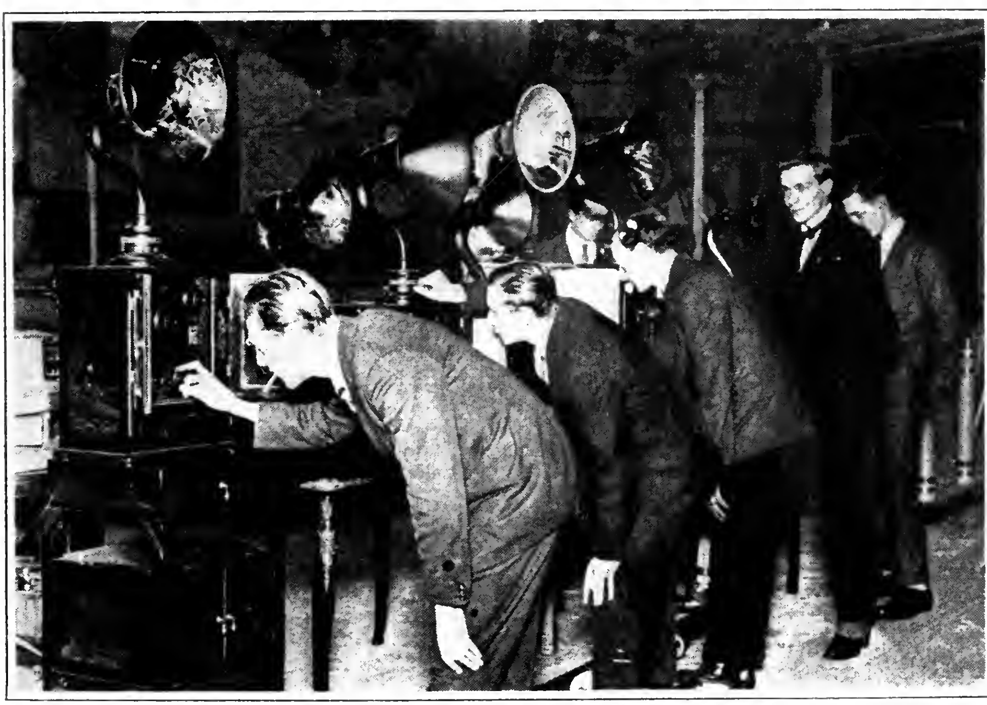
We have always thought that airship transmission could only be carried on over short distances. It would be remarkable enough if an airship could keep in touch with its base even by land-station relaying, but if the performance of the *Shenandoah* is to be regarded as other than freak, such relaying may not be necessary. The dirigible, anchored at her mast in San Diego, was using a 50-watt set adjusted to radiate on 90 meters. Her signals were picked up by one of the navy boats while cruising in the Pacific 4400 miles away. At the same time the naval air station near Washington was in almost daily communication with the *Shenandoah*, separated from Washington by the whole span of our continent.

Two British amateurs, one in England and one in New Zealand, with home-made equipment, have been able to communicate with each other, although half the earth's circumference intervened. Remarkable as this may sound, we shall probably hear of such feats more and more regularly. An American amateur, H. Johnson, at Short Beach, Connecticut, reports that he held two-way communication with a New Zealand amateur, the distance between them being 9000 miles. But all these transmissions must still be regarded as freaks by any honest observer.

The Artist, Not the Broadcaster, Must Pay Radio Royalties

A DOUBLE bomb shell landed in the camp of the American Society of Composers, Authors, and Publishers when Federal Judge Knox handed down his remarkable decision recently on the question of royalties and broadcasting. The owner of the copyright of a piece of music had asked the judge to stop the unauthorized broadcasting of the music. The judge's decision if it is allowed to stand as the law, will do much to prevent the coffers of the abovementioned society from bursting with the radio harvest they had hoped for.

The first part of the judge's decision states that the artist is the one giving out the program, not the broadcasting station. The station, in other words, cannot be held responsible for royalties, no matter what the copyright situation may be. Royalties, if any, must be sought from the one sending out the program, namely, the performer. Secondly,



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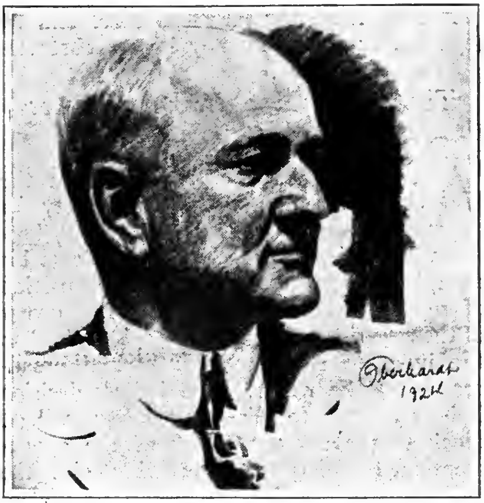
A CORNER IN THE LONDON RADIO SHOW

At Albert Hall. Some of the more enthusiastic of the visitors are testing several of the latest models of British receivers at close range. The inlay work in the radio cabinets is quite elaborate



GENERAL JAMES G. HARBORD

New York, President Radio Corporation of America

"Let me invite your attention to the developments in radio photography. Great strides in this direction have been made in the past year. It is not too much to say that we are in the eve of developments whereby it will be in the realm of possibility to transmit a complete newspaper page from London to New York by means of radio and in a fraction of the time it would take to transmit the entire text of the page either by radio or cable telegraph signals.

"Transoceanic broadcasting for purposes of entertainment is not yet in regular operation, but proposals for increasing the power of sending stations so that the programs from London and Paris and Berlin may be easily heard in America are carefully being considered.

"At present, transoceanic as well as marine radio messages are dispatched by means of telegraph code signals, but the transoceanic radio telephone, now under development through the American Telephone and Telegraph Company and the Radio Corporation, bids us to expect that before many years it will be possible and convenient for any one of us to pick up his telephone and in a short time be connected with his party in Europe, or with his stateroom, on some liner on the ocean."

that the performer, if entitled by license or otherwise to use the copyrighted music at all, can use it for broadcasting without additional payment of royalties. In other words, if the performer has acquired the right to sing to an audience of ten people, he may, at no additional expense, sing it to 10,000 people over the radio channel.

This decision, if allowed to stand as the law of the land, is the most important that has been handed down since broadcasting began, insofar as the general broadcast listener is concerned. It undoubtedly makes the royalty collecting agencies moan with anguish, but the millions of radio listeners will no doubt agree that it is a wise and proper decision.

Some of the New York *Times* correspondents have been acrimonious about an editorial which appeared in that paper commending Judge Knox's solution of the question: "People who get their music over the radio do not buy it." "Broadcasting is a sort of bonus to promote the sale of radio sets." "This profit is partly due to the fact that the broadcaster steals the music"; After much of such baseless argument, this writer winds up with a statement which shows he is at least as human as the rest of us. "However, it (Judge Knox's decision) will probably not undermine respect for the law except in a comparatively small class of artists. Nearly everybody is in favor of a law which confiscates the other fellow's property."

Interesting Things Interestingly Said

L. A. NIXON (New York; Secretary, Radio Trade Association, in a report on present broadcasting plans): "It seems to this committee that the true regulation of the power of a broadcasting station should be based on the listener; on the ability of the listener to discard the program offered by the high powered station and select another program in its place.

"Restrictions should be placed on the interference caused by the transmitting station in the receiving set, rather than the power generated. By such a plan, it would be possible that a twenty-five KW station located in some places in the country might cause less interference than a fifty-watt station located in densely populated centers and poorly tuned."

JAMES C. EGBERT (New York City; Director, Columbia University Extension Service): "About a thousand persons took the Columbia radio extension courses last year, and a great many more merely listened-in. This use of radio for education is as yet in an uncertain stage, so that it is impossible to say yet just what the results will be. We have had definite courses of instruction and have issued syllabuses which served as guides for the lectures. We shall now issue syllabuses and give opportunity for the radio student to send answers to questions given by the instructor. These will be criticised and returned to the student. In this way, we shall test the efficacy of this new method of popular education."

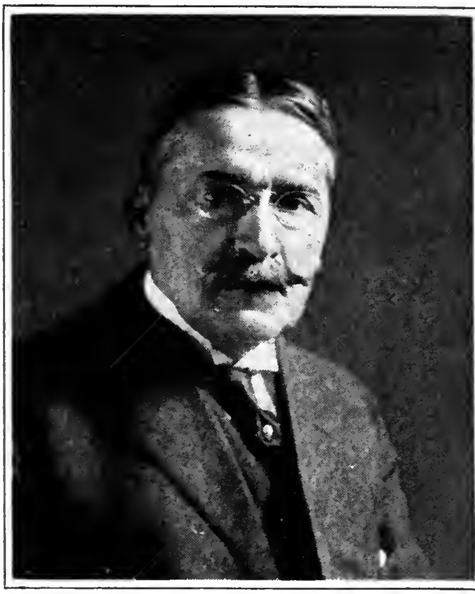
GUGLIELMO MARCONI (London; In a statement opening the New York Radio World's Fair): "Since last year, great strides have been made in the art of broadcasting, both in the United States and England. There have been some important developments in simultaneous broadcasting from several stations, and I believe that on certain occasions in the United States, vast audiences of no fewer than 25,000,000 people have listened to a broadcast address. I anticipate that in the not far distant future, this great achievement will be surpassed and the broadcasting of messages throughout the world will become a matter of everyday occurrence. We on this side of the Atlantic are looking forward to the day when we can listen to American speakers on subjects of common interest."

GIMBEL BROTHERS (New York City; in an advertisement announcing the opening of their new broadcasting station WGBS): "Broadcasting, as we see it, is a limitless force in the hands of a limited number. With some comprehension, we believe, of the invaluable possibilities of radio, and with a deep sense of the responsibility assumed by the broadcasters, WGBS begins its broadcasting experiment with the desire to employ itself in the development of programs in keeping with, and worthy of a force of such power. WGBS wishes to be a public servant in the full sense of the word."

THE NEW YORK *SUN* (New York; in an editorial about broadcasting and politics): "With the tremendous volume of political talking that has been broadcast, there has necessarily been a great deal of listening. Of course, nobody can measure it. But this is certain: only the listener chronically and bitterly opposed to politics has escaped hearing more about the campaign than he would otherwise have heard. Probably a great number of the voters at the polls this year went because of a quickened interest caused by radio.

"This is as much as any believer in radio could ask. Radio is only a mechanical device. If it gives the politician an opportunity, that is all he can ask of it."

DEPARTMENT OF COMMERCE News Service; Washington: "The activity in amateur radio work and in broadcasting is still greater in the United States than in any other nation, the past year has brought about marked changes in the situation in many foreign countries. Naturally, the development has had its greatest growth in Europe. In the British Isles, France, Germany, Sweden, Switzerland, Holland, Belgium, Denmark, and Czechoslovakia, the broadcasting of programs of entertainment and news is on a regular basis. In Italy, Finland, Spain, and Austria, programs are sent out at irregular periods. There is a decided likelihood of regular schedules being adopted in the near future. In South America, Argentina stands out as having made the greatest progress in the dissemination of music and other entertainment by radio telephony. Chile also maintains a regular broadcasting service."



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PROFESSOR MICHAEL I. PUPIN

Department of Electromechanics Columbia University

"The weakest point in democracy has always been lack of appreciation of expert knowledge. Railroads, telegraphy, telephony, radio broadcasting, electrical lighting, and electrical transmission of power are certainly public utilities, but the intelligent people of the United States will never consent that these things, requiring an enormous amount of intelligent expert knowledge be placed under government ownership. The machinery of our government, or any other government known to man to-day is utterly incapable of handling technical problems which require the highest type of training applied to the highest type of intelligence.

"All of these public utilities are full of complex technical problems which cannot and never were intended to be handled by any government. In Europe, we see where there is government ownership, the utilities are being run at very heavy deficits."

E. F. MC DONALD, JR. (Chicago; President, National Association of Broadcasters): "There is an effort afoot to change the name broadcasting to radiocasting. I wish to go on record as voicing a strenuous objection. Without explanation, ask one hundred people on the street what radiocast means, and the chances are if they answer at all, it will be a guess that the word has something to do with a radio receiving instrument. Ask the same group what broadcasting means, and they will tell you correctly. There is nothing to be gained by making the change. Why have this new word when the vernacular already offers an adequate term?"

For the Love of Mike

By A. COOPER ALLEN

Drawings by George C. Williamson

IT was the night before Christmas and all through the house there was a subdued air of expectancy. The light from the shaded reading lamp cast its mellow rays upon the big padded arm chair before the cheerful grate fire and crept partially up the four walls, leaving the ceiling in semi-darkness. The atmosphere of the room was warm and redolent of peace and piquant odor of cedar.

Curled in a heap in the deep padding of the big chair was the boy, his eyes glued to the pages of a book. Occasionally he stirred, turned the pages, muttered below his breath and continued to read. The curly haired dog—the boy's sole companion—lay comfortably dreaming on his rug at one end of the davenport, all unconscious of the joyous Christmastide.

Over against the wall in the dining room was dimly outlined a long table which gave back a glitter of silver, cut-glass, and the gaudy colors and tinsel of a small ornamented tree. Here and there about the two rooms were wreaths of Oregon grape, holly, and the red, red, berries of the madrone—for this was a home in a little Oregon valley.

The silence was absolute until there suddenly came a half uttered whine from the dog. It ceased almost as quickly as it came. A few more moments of silence then again the half-whining bark. The great chair creaked and the boy looked around at the quivering muscles of the dreaming dog. For a moment he regarded the animal intently as the peculiar barking increased and the dog's legs moved spasmodically as if in a labored run.

"Aw, cut it out!" growled the boy. "If you want to ride that nighthorse, hike into the kitchen."

The dog slowly opened his eyes, blinked a few times and promptly resumed his interrupted nap. With a yawn the boy slumped again into the chair and flipped a page of the book.

Dead silence again. Only the tick-tock of the clock was heard. The boy's head drooped over the pages and then a faint tinkle, tinkle, as of bells came on the air. Santa Claus! The youthful eyes opened, the head raised and he listened. Plainly it came—tinkle, tinkle, tinkle.

The big chair creaked, the boy slid out and stood listening. Again came the tinkle. The boy moved to the back part of the house and a sleepy voice broke the silence.

"Bobbie, is that you?"

"Yas'm."

"What are you doing?"

"Lookin' for Santa Claus—whadayu s'pose? I heard his bells."

"Bells?" came the female voice with a rising inflection. "What *are* you talking about?"

"Well, I heard sleigh bells out back and came to investigate," retorted Bobbie.

"Find out?"

"Sure."

"Sleigh bells?"

"Yah-h-h," he drawled. "Bunk. It's rainin'—droppin' from the roof on tin cans. Never have snow here. I wish——"

"I've told you to carry those cans away," interrupted the voice, "and you had better—"

"Uh-huh," grunted the boy and the door slammed as he returned to the chair.

Silence again, and then a stealthy noise at the front of the house. The dog pricked up his ears, jerked his tail a couple of times, and closed his eyes again—the figure in the chair did not move.

A SLIGHT scratching at the door then the knob slowly turned and the figure of a man with dripping hat and coat came through the opening. Furtively he looked about then entered bearing a long, oblong, bundle under his arm. Silently he crept across the room toward the Christmas tree on the table.

He was undoubtedly Santa Claus but clothed in the conventional garb of the average business man. The only possible method of identification of the merry elf was his mysterious, stealthy, entrance. It was evident he feared discovery as he cautiously moved across the floor. He passed the high back of the big chair and glanced at the dying embers of the fire. Then he halted suddenly, arrested by a voice from the padded depths of the chair.

"'Low Sandy Claus. Whatcha got?"

"Bobbie! What are you doing up, at this time of night?"

"Readin'."

"Reading? What is so interesting to keep you up this late?"

"Gulliver's Travels—book review—school—all bunk," and Bobbie squirmed and yawned.

"Well, you hop to bed—right now. How do you expect Santa Claus to come if you sit up all night? It's Christmas right now."

"All right, Dad—I'm goin'," and Bobbie uncurled his six feet of seventeen year old sinew and sauntered out.

"Merry Christmas, Dad! Call me early!"

Dad grinned and continued his journey across the room, planted the long package carefully upon the table and swept the polished silver tableware ruthlessly to one side. Then he removed his dripping hat and coat, hung them carefully in a pile on the Davenport and again opened the front door. Here he picked up sundry mysterious bundles, placed them on the table by the diminutive tree, muttering to himself "A battery, B's, horn." Seating himself at his desk he sought for and found a card and wrote rapidly upon it, placed it upon the large package and, snapping out the light, sought his room.

AGAIN the cheerful fire upon the hearth, the peaceful quiet room, now flooded with light. In the big chair was Dad, a brand-new pair of slippers upon his feet, a new smoking-jacket about his shoulders, and a pair of horn rimmed glasses upon his nose. In his hand a magazine, the page before his eyes lined with many names and strange hieroglyphics such as PAQ, KXY, WBG, etc.

On the table in the corner stood an oblong, mysterious looking, box with strange dials on its black face and beside it a queer black horn turned its mouth toward the room. Before this strange box sat Bobbie, the expression on his face denoting highly concentrated thought while his fingers manipulated sundry wires leading in from the window. From back in the kitchen now and then came the rattle of dishes and snatches of song where Ma was busy putting away the remains of the Christmas dinner.

Bobbie tightened a wire to a series of small, red-topped, boxes studded with brass taps, leaned back, and the concentrated attention changed to one of pleased expectancy.

"HE WAS UNDOUBTEDLY SANTA CLAUS
But clothed in the conventional garb of the average business man"

"Got her hooked up," he announced.

Dad grunted and looked around in his chair, his eyes peering over the horn bows. Of course Dad had no great interest in the affair, for he was not very much impressed with radio.

"Turn her on," he suggested after a wait.

"Well, I have, haven't I?" grunted Bobbie.

"Can't hear anything," apologetically.

"Give her time, can't you?"

Dad subsided, but, though the magazine was held before his eyes he saw nothing—but his ears were twisted to the rear like a mule's.

Silence—dead silence. Bobbie turned the dials backward and forward. Silence.

Bobbie lifted the cover. Inside, five tubes glowed with mellow light midst mystic combinations of wire and strange apparatus.

"It says here——" began Dad, but was suddenly stopped.

"I don't care what it says—I'm doing this."

"W-e-l-l," drawled Dad, "you are evidently doing it wrong. I told you——"

"I got it," broke in Bobbie. "Got my A battery poles reversed. Now . . . ."

"THAT CONTRIVANCE PROMISES TO DRIVE US ALL OUT"

A slight sound issued from the horn, Bobbie twisted the tails of the dials. The hissing turned to a frying sound.

"You've got the kitchen," ventured Dad facetiously. "I can hear bacon frying."

"For gosh sakes! Can't you keep still? I'm gettin' 'em, if——"

Dad left his chair and stood before the yawning mouth of the horn. Strange murmurs, crackles, and the sound of frying came forth. They listened in strained attention as the dials slowly turned. Suddenly there was a squawk and a whistle—then only buzzing.

"Nearly got 'em that time," Bobbie exulted.

"You bet," Dad agreed heartily. "I heard him whistling for his dog."

BOBBIE'S hands dropped from the dials and he sank back in his chair as his gaze rested upon his father's face in utter disgust. Dad subsided and sought sanctuary in his chair. Bobbie returned to the dials—there were three big ones with some kind of scale marked on them, and there were a couple of other knobs. Bobbie was busy and his neck was stretched to the limit trying to get his ear nearer the horn. Faint sounds as of distant music and voices seemed to come from a hundred miles back in the black throat of the horn. Bobbie strained his ears and Dad held his breath in wrapt attention. Then a door at the back of the house slammed, dishes rattled and a woman's voice rolled through the room warbling snatches of a Christmas carol. A muttered explosion was half smothered in the throat of the boy as he impatiently thrust back his chair and made for the sound—Dad only gasped.

Bobbie returned and left silence behind him —Dad grinned.

Again the slow, deliberate, turning of the dials without result. Then the voice from the chair:

"Jones just turns one dial and gets 'em right away and——"

"Y-a-h-h-h-h!" came scornfully from the young hopeful. "Single-tube regenerative—cheap—this is different. Ah-ha!"

This time it was unmistakable. Far back back in the foothills of the machine could be heard a woman's voice—high soprano. Dad slid out of his chair and stole silently up behind the absorbed operator. Back and forth Bobbie moved the dials and the illusive sound died away or returned, according to the manipulation of the dials. He placed his

hand upon a knob and began to turn. The volume increased and suddenly burst forth in all its glory and power: *"Zitty-zit-zit-zit. Zitty-zit-zit-zit."*

Dad snorted. "It's a Zulu lullaby," he laughed.

"*For the love of Mike!*" shouted Bobby in high dudgeon. "If you can't keep quiet, get out! I was just about to get 'em——"

"Seems to me you got a whole beehive that time."

"Gosh darn it—that's just like you. You don't know the telegraph code when you hear it and—and—oh, heck!" What's the use!" Bobbie threw a switch, the sounds ceased and he pushed back his chair.

Ma, in the kitchen, saw the door open slowly and Dad appear looking over his glasses in a quizzical way.

"What's the matter?" she demanded, realizing there was something in the wind.

"I beat it," explained Dad. "He got a Zulu band or a hive of bees or something buzzing around in the horn and——"

"I suppose you had some smart remarks to make about it?" she broke in accusingly.

"I only joked him a little," he acknowledged and his tones implied guilt.

"Well, you leave the boy alone. I," with emphasis, "think he is doing just fine—it isn't every boy his age, and never having had a radio before, could do as well. He——"

"He hasn't got a thing yet. Cost nearly two hundred bucks—I told him they are just in the experimental stage—never heard anyone get anything but whistles and howls and noise."

"But this is different," Ma stoutly defended her idol, "this is a—a—well, it's some kind of a dyne and *it* won't make those noises."

"It's already making them. If you don't believe it, go listen to it."

"Then it's all your fault. You allowed yourself to be cheated." positively declared Ma. "You know I told you to be careful."

"I got the one he picked out."

"It was probably a bargain—you always opposed the idea so you just picked any old thing and——"

But Dad had fled. As he wasn't ready to go to bed and he wouldn't go out he could only return to the "studio." He was completely bluffed so he sneaked in on tip toes, for Bobbie was once more at the machine. He made about four steps when Bobbie whirled.

"For the love of Mike! Can't you keep still? Your shoes squeak so I can't hear a thing."

"I got to move, don't I?" Dad defended himself and sneaked toward his chair. The slippers were new and Dad was not conscious there was a very mild, weak, little squeak in them. He halted with his back to the fire watching his son who had again turned to the dials, then, after several minutes, sat down in his chair, wriggled into a comfortable position and opened the evening paper. Instantly the storm broke.

FOR the love of Mike! Just as I had 'em you——"

"Dad-burn it, do you expect me to sit here and twiddle my thumbs all evening?" Dad began to grow a bit irritable. He had opposed the installation of the "infernal thing" on the grounds of cost. He thought this business too "purely experimental." He had not expected to hear anything very much out of the set and, from self defense, had gone the limit and purchased what they had thought was the best and newest on the market, thereby hoping to get a slight return for his money. He was prepared to swallow his loss and expected failure, but he had not counted upon his peaceful home being rent and turned into a domestic battlefield. The flames of combat began to burn and, as Bobbie had much of his own disposition, the fur promised to fly.

EVERY NOTE CAME THROUGH CLEARLY

"Well, you can listen, can't you? That's what it is for."

A stinging retort was on the tip of his tongue when a movement in the shadows of the next room caught his eye and Ma beckoned to him. He arose and, with bristles standing straight up, stamped into the kitchen.

"Now, Dad," she began when she had closed the door behind him, "remember, this is Christmas and there should be peace——"

"Peace!" he shouted. "Ha, ha, ha! Ever since that blamed thing was turned on there has been nothing but growls and snarls. Why can't you all be good natured and tolerant like I am? This *is* Christmas but, all you two do is to try and brow-beat me and——"

There was a sound at the door and Dad opened it. The dog sneaked into the room with tail between his legs and sought a secluded corner beneath the kitchen table, for he had indulged in an ardent flea scratching bee just when Bobbie had again "nearly got 'em."

"See! See!" Dad exulted. "Even the dog had to beat it. That contrivance promises to drive us all——"

"*Dad! Dad!*" came excited cries from the front room and, forgetting all his troubles, Dad answered the call with Ma following close behind. Bobbie was sitting back, his face wreathed in a happy smile, as there came floating from the horn, and filling all the rooms, the clear, sweet, notes of an orchestra. There was no doubt of it, for every note came distinctly and without distortion. Dad and Ma halted on either side of the happy boy—Ma supremely blissful and tears of pride in the eyes of Dad as he rested one hand upon Bobbie's shoulder.

"Who is it?" whispered Dad in awed tones.

"Don't know yet—listen!"

The sweet strains died away. There followed a moment of silence, then a clear voice distinctly announced the call letters and the name of the city.

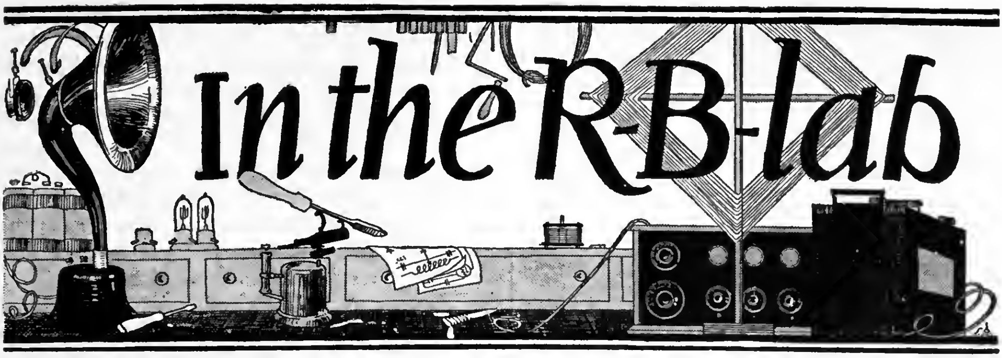
"Pittsburgh!" exulted Bobbie.

"Pittsburg, and this is Oregon!" echoed Ma in an awed whisper.

"Pittsburgh!" proudly exclaimed Dad. "For the love of Mike!"

E. F. W. ALEXANDERSON

Chief consulting engineer of the Radio Corporation of America examining the automatic receiving apparatus at Radio Central, Riverhead, Long Island



STANDARD THREE-CIRCUIT COILS AND THE ROBERTS RECEIVER

THE principal difficulty encountered in the construction of the several Roberts receivers described in recent issues of RADIO BROADCAST is the obtaining or construction of the designated spider-web coils, and the mechanical arrangement of the variable tickler. Spider-webs have been recommended by the various authors, regardless of the possible inconvenience, probably because such inductances were specified in the original article by Mr. Roberts, and because, as experience has shown, it is not an over easy matter to design other inductances for this receiver.

The spider-web is not a particularly efficient type of inductance (which again dispels one of radio's pet illusions), several engineers having found it inferior to the conventional single layer coil (the solenoid) for a given value of inductance.

After several months of experiment, this department has found the several problems of the Roberts inductances solved for the average builder by adapting the standard three-circuit tuner to the requirements of the more efficient Roberts circuit. These coils are widely purchased under a variety of trade names—such as "The Ambassador Coil," "The Trans-Continental Tuning Coil," "The Uncle Sam"—etc., all of which are characterized by three windings, primary, (antenna coil), secondary (grid coil) and the rotating tickler (plate coil). There is little electrical difference between the various makes of these coils, and any one of them, with the addition of a few turns of wire, may be substituted for the usual spider-web, radio-frequency transformer and tickler in the Roberts set (T2, Fig. 2).

First count the number of primary turns—of which there will generally be from fourteen to sixteen. Place a layer of tape over the primary winding, and connect one end of a sufficient length of No. 22 wire to *the binding post which represents the primary terminal nearest the end of the tube.* Wind over the tape exactly as if you were winding a second layer of the primary over the first layer, winding to one turn less than the original primary. You will now have a *transformer* primary, and a neutralizing coil with one terminal common. In wiring the receiver, the common post leads to the plus B battery, the two remaining terminals running, indiscri-

In the R. B. Lab This Month

SHORT ARTICLES ON—

—Three-circuit tuner coils for the Roberts set.

—A one-stage resistance-coupled power amplifier.

—Loop sets on outdoor antennas—Why this is inadvisable and how it should be done when necessary.

—A one-tube receiver that works on a loop accomplished by radio frequency and regeneration.

"Building your own lab"—The slide rule and how it can help you in your work.

—and short lab notes that may mean a lot to you.

We are endeavoring to make "In the R. B. Lab" the most valuable single department to you in RADIO BROADCAST. *Tell us what you would like to see in it—some particular experiment or test that has been puzzling you.*

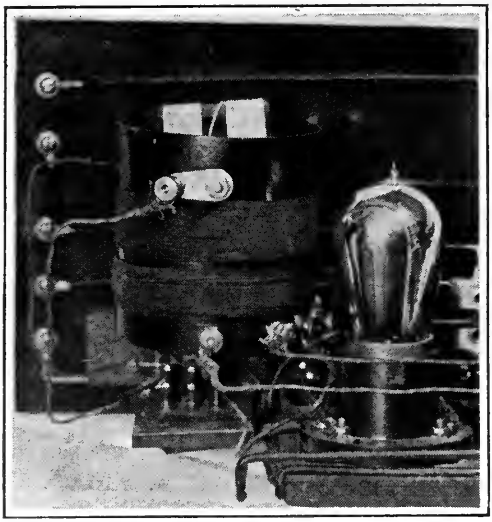


FIG. 1
The three-circuit tuner in an experimental Roberts set. The extra winding can be seen on the lower portion of the coil

minately, to the neutralizing condenser and plate of the radio-frequency tube. (This is exactly as directed in the articles describing in detail the construction of the Roberts receiver). Fig. 1 shows the arrangement connected in the R. B. LAB.

Fig. 2 shows the circuit in which the modified coupler was used as T2. P1 and P2 refer to the primary and neutralizing windings, S to the secondary, and "tickler" to the rotating coil, the last two windings being connected as in the usual three-circuit arrangement. T1 is the antenna coupler, the secondary of which consists of forty turns of wire on a three-and-a-half-inch form. The primary is wound alongside of the secondary with fourteen turns of wire. This forms a semi-tuned primary, the ground side of which is connected to the filament lighting battery. The usual type of tapped primary can be used if desired.

For further details and operating data, the reader is referred to any one of the numerous articles on the Roberts set appearing in the August, September, and October, 1924, numbers of RADIO BROADCAST.

A ONE-STAGE RESISTANCE-COUPLED POWER AMPLIFIER

AS WAS demonstrated in this department last month, the tendency of a receiving system toward instability increases more or less directly with the number of tubes. For this reason, the addition to a multi-tube receiver of still more tubes, such as a single stage of power amplification for use on distant stations and dance purposes, must be effected with unusual method and care. In many cases an extra stage of transformer-coupled power amplification to a many tube reflex or super-heterodyne receiver proves to be the straw that breaks the camel's back, precipitating the system into almost incurable oscillations or squeals.

The characteristics of resistance-coupled amplification, which made effective the attempts at stabilizing the three-tube reflex receiver as described in the R. B. LAB. for December, recommend this method of amplification as a final stage of power intensification free from the complications attending a similar step of transformer coupling. (Resistance coupling and its particular qualifications in final amplifying stages, has also been described in greater length in "How To Make A Knock-Out Amplifier" featured in the same issue of RADIO BROADCAST.)

Figs. 3, 4, and 5 are descriptive of a single stage of resistance-coupled power amplification, for use as an external and auxiliary amplifier. Fig. 3 illustrates the amplifier built up on a base board for experimental and lab work, while Fig. 4 suggests a more finished cabinet model, designed to conform in appearance and for use with the Haynes super-heterodyne receivers described in several numbers of RADIO BROADCAST. The circuit is shown in Fig. 5.

The coupling resistor, R1, is generally a one hundred thousand-ohm resistor, though this value often varies in either direction, following a stage of transformer-coupled intensification. A one hundred thousand-ohm resistor, when using one hundred and fifty volts or less on the plates, may be a Daven special coupling resistance, which will clip into the Daven resisto-coupler shown in the photograph. However, if higher voltages are used on a one hundred thousand ohms or lower resistance, a Crescent Lavite is recommended. On resistances above one hundred thousand, the Daven unit may be employed almost regardless of plate potential.

The coupling condenser, C1 is a .006 mfd., Micadon.

A power tube, such as the W. E. 216-A is recommended, with a gridleak of 100,000 ohms.

The input of the single stage resistance-coupled amplifier is coupled to the output of the preceding amplifier in the usual manner

—i.e., substituting the input connections for the loud speaker. The lead from the upper end of the resistor, however, must run to the plate of the preceding bulb.

USING LOOP SETS ON ANTENNAS

PROBABLY the best way of disposing of this question would be to state emphatically that it should never be done. There are two excellent reasons why engineers and reputable magazines frown upon this procedure. In the first place the arrangement is deliberately inefficient. Apparatus designed for loop reception is ultra-sensitive—it is made receptive to the comparatively weak impulses supplied to it from the coil antenna by the rather prodigal use of extra radio frequency stages that are not merely unnecessary but actually undesirable on antenna reception. Less theoretically, it is possible to design a three-tube antenna receiver (the Roberts for instance, plus one stage of transformer-coupled audio amplification) that will do everything that a seven-tube super-heterodyne will accomplish working on a loop.

The second consideration dispels the rather prevalent misconception that if a receiver works well on a loop, it must necessarily function many times better on an open antenna. Such is far from being the case, particularly with a receiver primarily designed for loop reception. Connecting such a set to the antenna merely raises the noise level. There is a more or less definite limit to the strength of the signal which a radio-frequency amplifier can feed to the detector tube—a limit that is occasionally reached in the case of loop reception. Hence it is obvious that on such stations, the use of the antenna will merely bring up the extraneous noises—atmospherics, arc light interference, etc. to this same limit of audibility—i.e. until these undesired sounds are quite as loud as the desired signal! Weaker signals will of course be amplified more than on the loop, but owing to the raising of the noise limit they will be anything but enjoyable if heard at all. (Incidentally, a good loop receiver will bring in most signals above the noise level, at the point of reception—that is, signals that are louder than the undesired but inevitable static and similar disturbances. Thus the effect of operating such a receiver on an antenna would be to lower the signal to the noise level.)

An additional and very weighty argument against antenna operation is found in the case of the super-heterodyne, where a continuously oscillating bulb is coupled into the antenna circuit. Such an arrangement is a radiator—one that will produce a continued squeal on stations slightly above or below the transmitter to which the "super" is tuned. Investigation has shown this receiving system (the "super" closely coupled to the antenna)

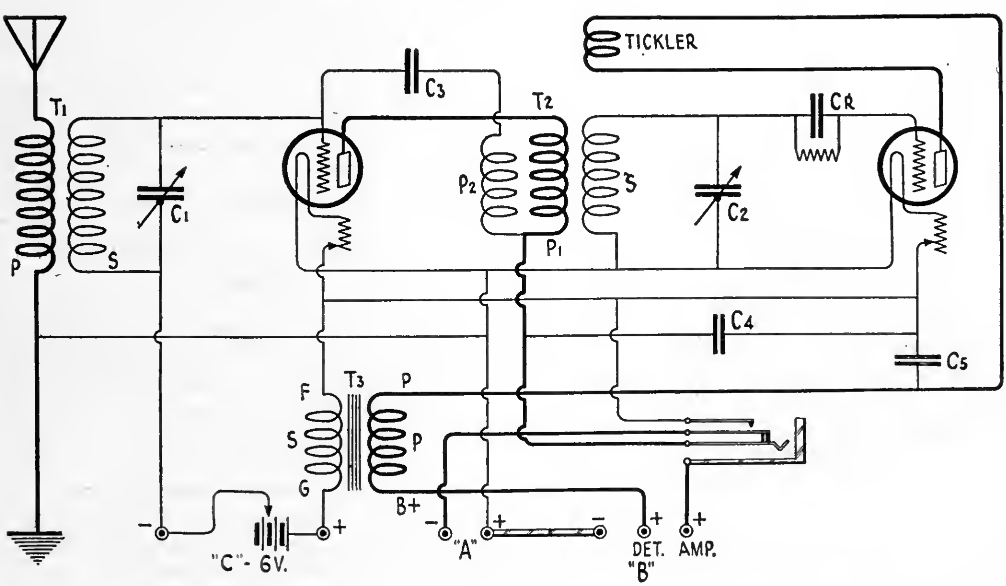


FIG. 2

The standard three-circuit tuner as adapted to the Roberts circuit, in the R. B. LAB. If the reader prefers, T, may be the usual tapped coupler

the source of many squeals usually attributed to a heterodyning distant transmitter.

Unfortunately, advising against this procedure will not solve the problem. Indeed, in some cases, such as in transoceanic reception and similar tests, the *proper* use of a loop receiver on an open antenna may be justified. However, a good bit of the justification lies in the word "proper." Coupling *should never be made* by tapping on to the loop, by the use of a tuning coil or by a standard variocoupler. In all of these cases, the coupling will be considerably too tight. Tight coupling results in two more or less obvious undesirable conditions—the raising of the noise level, and radiation in the case of the "super."

A simple and acceptable manner of experimental coupling, which will determine if yours is one of the few loop receivers that benefit from antenna operation, consists of two turns of No. 18 or any other self-supporting wire, with a diameter of about one foot, suspended a few inches from the loop connected in the usual way. One side of the additional coil is grounded and connected to the minus terminal of the filament lighting battery, the remaining terminal running to the open antenna.

A less experimental type of coupler may be built up in accordance to Figs. 6 and 7. The two coils are wound on a three-and-a-quarter to three-and-a-half-inch tube, with an inch and a half separation between primary and secondary. The ten-turn or primary winding is connected to antenna, ground, and A battery in the manner suggested for the two-turn coil, while the forty-turn inductance or secondary is substituted for the loop. No. 18 annunciator or magnet wire can be used in place of the designated wire. The completed coils are mounted in back of a seven by five inch panel. The coupler photographed has been mechanically designed for use alongside of a Radio Broadcast super-heterodyne described by A. J. Haynes in this magazine in January and March, 1924. Electrically, it will give equally good results on the Grimes and similar reflex circuits.

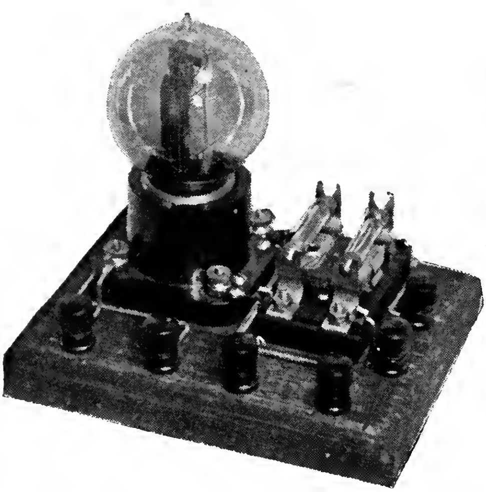


FIG. 3

The one-stage resistance-coupled power amplifier built up on a base board for lab and experimental use. One hundred and forty volts were used on the plate of the W. E. 216-A tube shown in the photograph

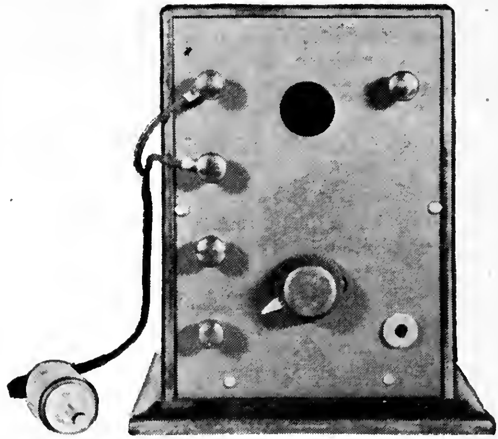


FIG. 4

A more pretentious layout of the power amplifier. It is merely plugged into the output jack of the preceding amplifier or receiving set

The use of the antenna will seldom increase signal strength on local and semi-local stations, and while better reception of distance may be effected, this can only be accomplished by also bringing up the noise level.

THE ONE-TUBE KNOCKOUT ON A LOOP

IT IS theoretically possible to operate any circuit from a coil antenna, merely by substituting the loop for the customary input coil to the detector or radio-frequency tube. Unfortunately, the effectiveness of a receiving system designed for antenna operation is generally seriously impaired when such a receiver is switched to loop operation. However, in the Radio Broadcast Knock-out single-tube receiver, a slight revision of the circuit develops into a receiver that makes loop reception on the head phones quite practical —the usual losses, being somewhat compen-

sated for by the circuit changes. The possibilities of such a receiver were first suggested to this laboratory by a reader, R. S. Ryan, and the resulting circuit is shown in Fig. 8.

Other than the substitution of the coil antenna for the secondary of the usual radio-frequency transformer, T1, the changes of the circuit consist of a liberal distribution of bypass condensers and the two hundred-ohm potentiometer, which contribute controlled regeneration that is doubtless responsible for the effectiveness of the single-tube loop receiver.

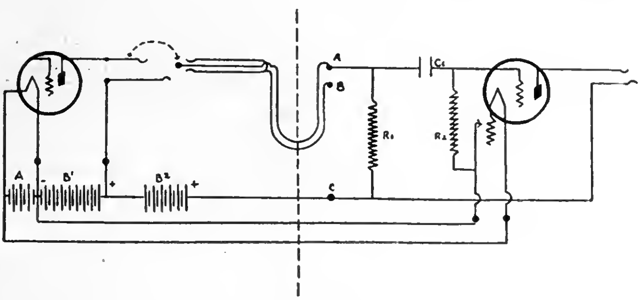


FIG. 5

The circuit, connected to the last tube in the super-heterodyne designed by A. J. Haynes. If the extra battery B2 is not used (when B1 is above 100 volts) B may be connected to C

T2 corresponds to the original specifications for this transformer, 63 turns being wound on a two and a half inch winding form, functioning as the secondary, followed by a layer or two of paper and the primary of thirty-six turns. Any convenient magnet wire, between No. 22 and No. 26 may be used. In the R. B. Lab. (Fig. 9) the Ballantine Varioformer has been found particularly effective in this one-tube loop receiver, the regeneration that is more or less objectionable when operated on an open antenna, adding considerably to the audibility and range of the loop set. When using the Varioformer, the condenser across the secondary T2 is, of course, eliminated.

The audio-frequency transformer T3 may be any reliable make—this laboratory recommending a medium high ratio—such as five to one—in which case the bypass condenser across the secondary is best dispensed with.

Under some conditions, it will be found advisable to use a ground connection, running to the minus side of the filament lighting battery.

A fixed crystal may be used with this receiver, though an adjustable detector, which can be operated on a comparatively high resistance spot, will permit greater regeneration. Try reversing connections to the crystal. A loop of standard dimensions will operate successfully with the receiver, though as usual signal response will vary directly with the size of the loop.

Though this laboratory has not been able to duplicate Mr. Ryan's reception record of 1000 miles, the results indicate that such a range, while perhaps not consistent, is quite possible. Local tations (within 25 miles) come in with enjoyable ear-phone volume, and when amplified with the Knock-out amplifier, described in the December number of Radio Broadcast, gives a signal of splendid volume and quality.

BUILDING YOUR OWN LAB

OUR suggestion this month is addressed in particular to the more serious fan—the experimenter—the embryo engineer, whose interest and inclinations prompt him to original and studied design. Our recommendation is a slide rule—preferably a Keuffel and Esser, ten inch polyphase rule. Such a rule, with leather case, retails at eight dollars, and is shown in Fig. 10.

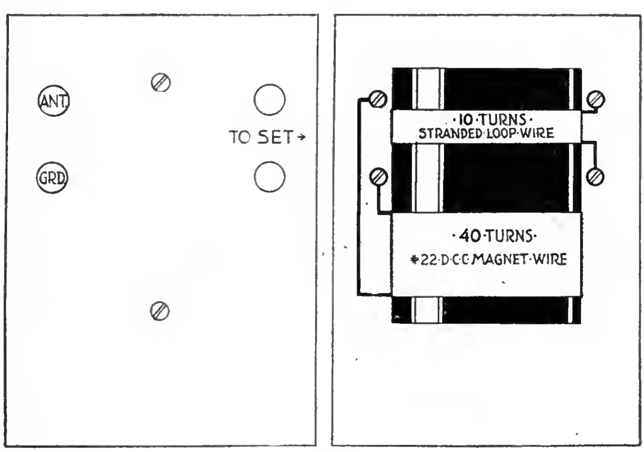


FIG. 6

Suggested layout for the antenna coupler

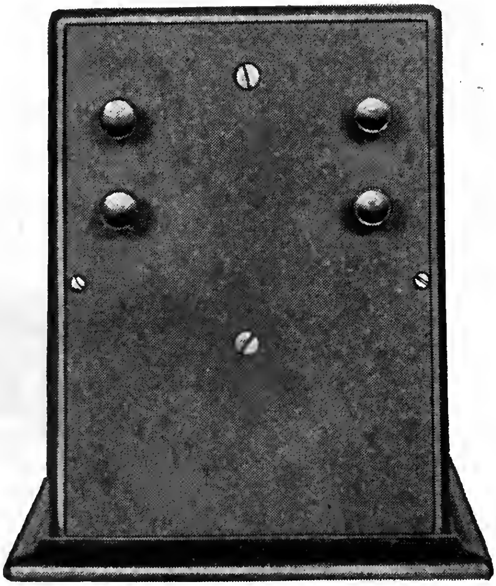


FIG. 7
The finished coupler

This wonderfully ingenious arrangement is equally a most capable assistant at desk and lab bench. The rule consists of a set of scales which, through their logarithmic interrelations make possible multiplication, division, squaring, cubing, the extraction of square and cube roots, the solution of ratios and proportions, the determining of logarithms, and the juggling of trigonometric functions practically without mental effort and in a small fraction of the time required to accomplish the same calculations in the usual way. The radio experimenter will find the slide rule particularly applicable to the solution of problems involving Ohm's law, and to the design of transformers where, given one winding additional voltages and windings are solved almost instantaneously, the changing of wavelengths to kilocycles, and in the thousand and one calculations to which lab work invariably gives rise. Tube curves and similar characteristics may be plotted with the slide rule in a tenth of the time required for arithmetic derivations.

Though the slide rule is generally associated with the more serious experimental endeavors, the fan with only the slightest inclination toward the design and engineering side of electricity and wireless will profit by possession and a working knowledge of the rule. The fascination of its ingenious possibilities is a powerful stimulant leading to a more comprehending appreciation of this science-art of ours.

LABORATORY HINTS

AN INVALUABLE assistant to the lab worker is a good manual of electrical engineering. Such a manual should cost five dollars or more. The experimenter will find arranged in it in a logical system, all the formulas, data and miscellaneous information that he has run across in his more or less haphazard reading and to which it is so often difficult to return.

THE modern vacuum tube (the De Forest DV-2, the Cunningham C-301-A and the Radio Corporation UV-201-A) is not at all critical in respect to detector plate potential, and in many cases requires higher voltage for most efficient operation than the older soft tubes. This is particularly noticeable in the super-heterodyne, when it may be found advisable to increase the detector plate voltage to ninety.

MOST loud speakers must be connected in the right direction in respect to polarity. If the direction of current is reversed the permanent magnets are weakened, and the efficiency of the speaker ultimately impaired. It is often difficult to locate the plus battery lead to a jack or plug. However, in the case of adjustable diaphragm speakers, it is easy to determine when the instrument is connected correctly, by noticing at what adjustment the "rattle-spot" occurs. When the adjuster is turned all the way to one side, the diaphragm of the speaker is generally in contact with

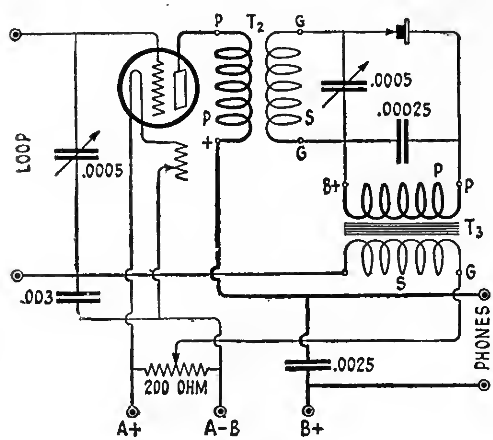


FIG. 8
The one-tube loop hook-up—the first cousin to our old friend the single-tube knock-out. If the Ballantine Varioformer is substituted for T2, the condenser across the secondary is eliminated

the magnets, or so near to it that it rattles badly on a signal. As the adjuster is turned away from this dead or inoperative side, the diaphragm is raised until it generally "plops" free. When the speaker is connected correctly, it will be necessary to turn the adjuster farther than on the incorrect polarity, to free the diaphragm and achieve distortionless reproduction.

FIG. 9
Testing the one-tube loop receiver in the R. B. Lab. Regeneration is quite pronounced with the Ballantine Varioformer

NEVER overload your loud speaker. The suspicion of a rattle should be avoided. Even momentary overloads lower the power capacity of the talker (in respect to satisfactory reproduction) and a loud speaker that has been occasionally strained will distort and blast on much lower powers than before the initial stress. This fact was ably demonstrated in a series of amplification experiments carried on in the R. B. Lab in which volume was a primary consideration.

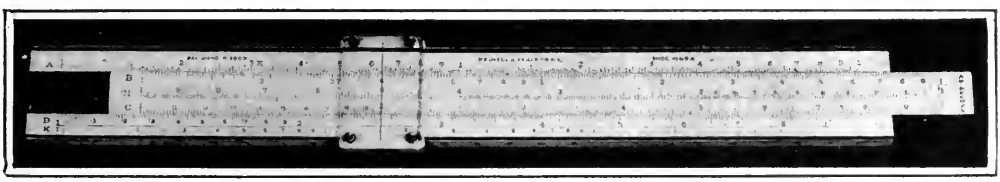


FIG. 10
The ten inch poly-phase slide rule or "slip stick,"—our laboratory suggestion for January

IN THE R. B. LAB SOON

The R. B. LAB is preparing data on low loss coils in the Roberts receiver, in both the broadcast set and the record-making short-wave receiver. This material will appear in an early number.

Pioneering With De Forest in Florida

High Adventure with Temperamental Wireless When Forty Feet of Sand Brought Failure Close—Despair, Expense, Trouble, and Final Success—How the Pensacola and Key West Navy Wireless Stations Were Built

By FRANK E. BUTLER
Former Chief Assistant to Dr. Lee De Forest

THE erection of five high-powered wireless stations in the South guaranteed to give perfect communication over a distance of one thousand miles was the flattering contract offered Dr. Lee De Forest by the United States Government after he had made his sensational success at the St. Louis World's Fair. Naturally, he was elated at such unqualified endorsement of this success coming from so high a source. And I, having worked with him during every hour of that long and desperate struggle, and having shared with him the final triumph, was equally elated.

The stations were to be built at Pensacola and Key West, Florida; at Guantanamo, Cuba; San Juan, Porto Rico; and Colon, Panama.

They were to be the first wireless stations ever erected in the tropics. They were to work over a distance two thirds greater than wireless communication had before carried. But what of it? Had we not smashed the world's record at St. Louis? As a preliminary to this stupendous achievement had we not conquered all installation troubles? This Southern job was going to be an easy matter now that we had the St. Louis experience back of us! There was nothing to worry about, even though this time we were working for the Government.

TOWER BASE AT THE PENSACOLA STATION
The masts were two hundred feet high. Each timber in the base is eight by eight

This was the way we felt the day we started for the South. But, alas!

That Southern trip, begun in 1905, lasted close to two years. In the exercise of patience and the development of skill it made those gruelling days at St. Louis seem as no more than a preliminary bout before the battle royal.

It was a battle from the very start. All nature seemed in revolt at our intrusion. She fought us with static overhead. It was fierce, relentless static such as was never heard before with the crude tuning devices at hand. She baffled us by "ground conditions" underneath that taxed to the utmost our perseverance and ingenuity in the effort to conquer them. She pestered us day and night with insects so vicious we grew to think of the mosquito as a friend. But we stuck. And we stuck until we conquered.

SCENE OF OUR FLORIDA STRUGGLES

MY FIRST stop was at the Warrington Navy Yard, Pensacola, where I was to have charge of the erection of a two-masted station with a fan antenna. This station was to be of 10 KW capacity, and although very similar to the St. Louis Fair installation, excelled it in refinements of apparatus and wiring. I had a special letter from Mr. Breckenridge Long, then Secretary of the Navy (under

President Roosevelt), requesting all navy officers to assist us as much as possible in our work, but it was not necessary for me to use it because the navy officers at this yard were always exceedingly courteous and helpful to us in every way.

For a time I lived at the hotel in Pensacola. But only for a time. As our troubles multiplied I found it necessary to be right on the spot day and night. So I moved down to the wireless station where I slept on a bunk and ate my meals with the "Jack Tars" in their mess hall. It was here among these happy fellows that I learned many things which have proved most helpful to me ever since. They patiently taught me the knack of tying knots and of rope splicing, accomplishments I afterward found most useful in making proper antenna construction. I was allowed access at all times to their machine shop and electrical department, and I had the advantage of their experience with heavy construction work, wind stresses, mathematical formulas, etc. And so, for weeks, all concerned in the erection of the station worked happily, undaunted by nature's enmity, worked with the persistent energy that comes from a surety of ultimate success.

When the installation was finally completed it had all the aspects of a beautiful job.

As the day arrived for the initial test, the stage was all set to begin the test signals at 8 P.M. Dr. De Forest was located at Key West, about 400 miles distant. He was notified to listen-in at the appointed time when we were to send out the accustomed "D" test signals. All of the reading instruments on the operating table registered perfectly, the spark across the spark gap was fast and powerful, and there was every indication of a perfect inauguration of service without delay.

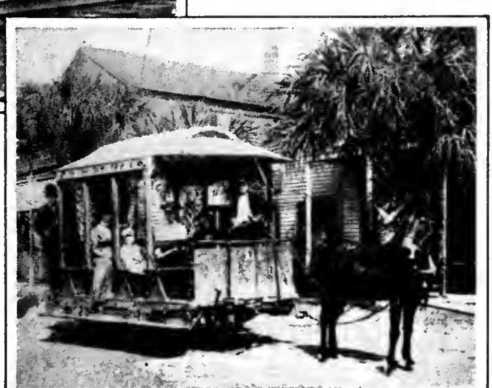
"WE SHOULD WORRY"

They seem to be saying, even though they are away down in Pensacola. Mr. Butler, third from the left, of this group of "Jolly Tars" is helping the boys form the lucky combination of "four eleven, forty four"

IT WOULDN'T WORK

THE battleship *Brooklyn* was anchored in the harbor about two miles distant. The wireless operator aboard had been a daily visitor at the station and was interested in the test, so he planned to listen-in that evening. It seemed ridiculous to us that he should listen in on a 10 KW station located only two miles away, but he did.

As I started the test I was positive of its success. I sent "D's" for hours, waiting



MUNICIPAL PROGRESS AT KEY WEST IN 1905

The lower cut shows the transportation system of the city. One car, one mule, one street. To board car, proceed to center of street. The mule then stops, turns head around, and will not start until passenger is aboard. The conductor at rear of car gives the mule "motorman" the bell twice and on you go until the "motorman" stops of his own accord at the other side of the next street. At the left, the diamond stack wood-burning locomotive that was still in use on the Florida railroads when Mr. Butler went from Pensacola to meet De Forest at Key West in 1905

anxiously for a telegram from De Forest at Key West. Nothing came.

However, at eleven o'clock, the *Brooklyn* operator came ashore in a launch and reported at the station. He inquired as to why we had not been sending, and added that he "had not heard a peep" from us.

The following morning a message was received from Dr. De Forest stating that he had not heard our signals.

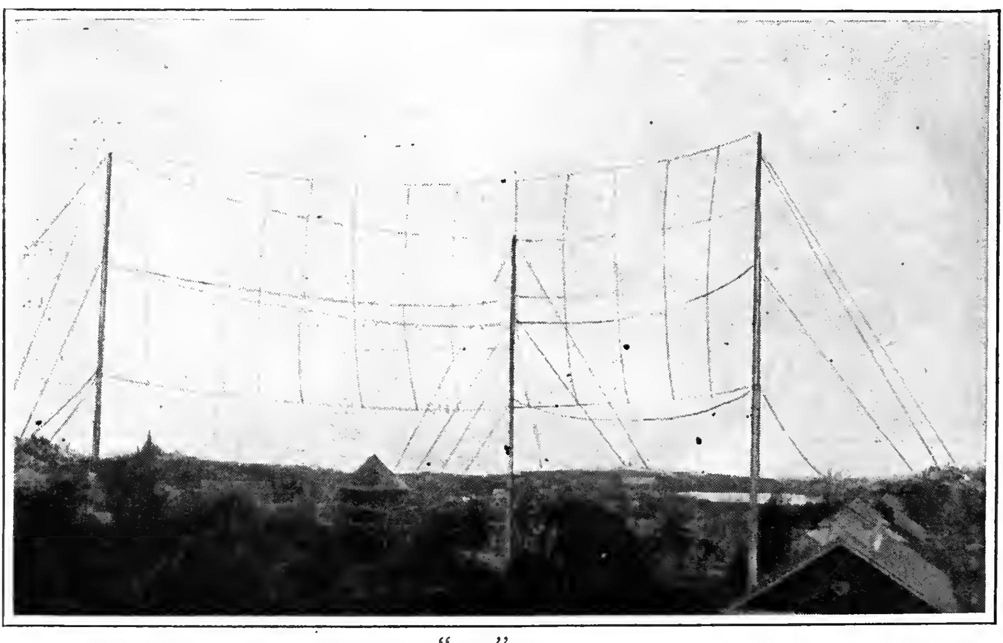
Every item of the installation was carefully checked over and not a flaw found. A slight change in adjustment was made and the test resumed that evening with the same result. This testing continued week after week with relentless patience and continual changes. Even the large spread fan antenna was taken down, closely inspected and replaced.

What Dr. De Forest Said of the Author

"Mr. Butler, is in fact the only surviving member of the "old guard" who is still interested in wireless and who is in a position to lay before the public, in a graphic and interesting manner, a gripping story of those old days and the subsequent development of radio under the De Forest banner. He has just read me the first three installments of a most graphic story of his early days in wireless, recalling a thousand interesting facts which I had forgotten, and in which every radio fan must be intensely interested."

The "ground" was an item of suspicion. This "ground" had been considered a good one for the reason that it was made of heavy sheet copper one hundred feet square and buried five feet underground two feet under water, and connected to the spark gap by a four-inch copper bus bar.

To make sure the ground was all right, we dug up the plate and prepared to sink it deeper into the sea water. To do this it was necessary to construct a cofferdam, and while a force of men shoveled out the sand another crew on each corner operated force pumps to keep out the water so the digging gang could work. It was slow, stubborn work. When a depth of eleven feet had been reached, we were compelled to stop further excavation on account of the increased rush of the incoming



"KW"

The De Forest station at Key West, erected in 1905 for the United States Navy. This spark set had a capacity of twenty kilowatts. The radio scenery at Key West now looks vastly different, what with the tall steel masts of the present modern Navy station now there

water. Then we dropped a new one hundred square feet of copper and buried it, feeling certain it would solve our ground difficulties. That evening we sent "D's" energetically and with renewed confidence in our success.

It was a staggering blow to receive the following morning the old accustomed telegram from Dr. De Forest, "Heard nothing." This was followed by some suggestions of another change and an admonition to keep up courage.

That day, when the clouds of despair were at their darkest, an incident occurred which, trivial in itself, was the turning point in our apparently hopeless battle with an unknown trouble.

It was a drink of water that brought about the idea that solved the Pensacola problem.

A DRINK OF WATER SOLVED THE PROBLEM

WITHIN a few rods of the wireless station was a well from which we obtained our clear, cool drinking water. As I strolled over to the pump to get a drink on this day I met a Navy officer who reached the spot at the same time I did. After the usual greeting, I said:

"This is fine drinking water. Wonder if it's a drilled well."

To which he replied:

"It is. I know because I drilled it."

"How deep?" I asked, and little realized the tremendous importance of the question.

"Fifty feet," came the answer. "But," went on the officer, "if I had stopped at forty feet or gone down to sixty feet, I would have had nothing but salt water."

"How's that?"

"Well, you see it's this way. This white sand around these parts is about forty feet deep, and below that is a stratum of clay and stone twenty feet thick, and beyond that is an indefinite reach of sand."

"Ah, I see," was my rather inane comment. But I was too stunned by the idea that had flashed into my mind to carry on the conversation further.

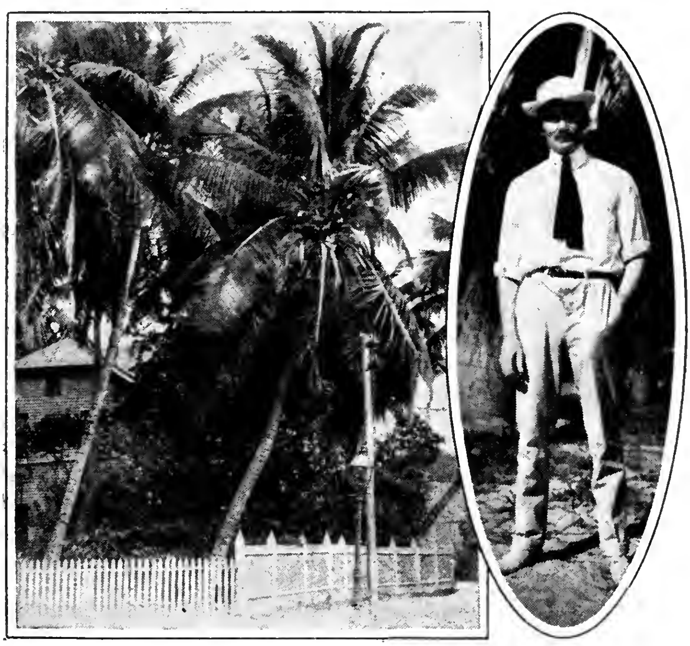
The idea was that perhaps that white silica sand, the body of which was greater than the thin film of seawater that seeped around it, offered too much resistance or formed a dielectric which prevented a good ground.

I spent the rest of the day absorbed with this idea. It still had full possession of me when, in the evening, I went to the Western Union office to send a telegram. Before I left I asked the operator what kind of a ground he had. He replied that the ground they used consisted of an iron pipe driven down forty feet, and that using any less than that produced no electrical results whatever.

That settled it. I was sure the solution of our baffling problem was at hand.

The following day I bought about six hundred feet of four-inch pipe and engaged men to drive twelve iron pipes each forty-five feet long into the loose, moist sand. These were grouped in a small circle about two feet apart. The twelve tops were joined together with heavy copper cable and a large bus bar run into the spark-gap.

The evening after this was finished we started sending "D's" promptly at 8 o'clock, and scarcely before I could realize it, the joyful news was received from Dr. De Forest that he had heard the first signals we sent out. To have success so suddenly thrust upon us after weeks of discouraging failures, was indeed a

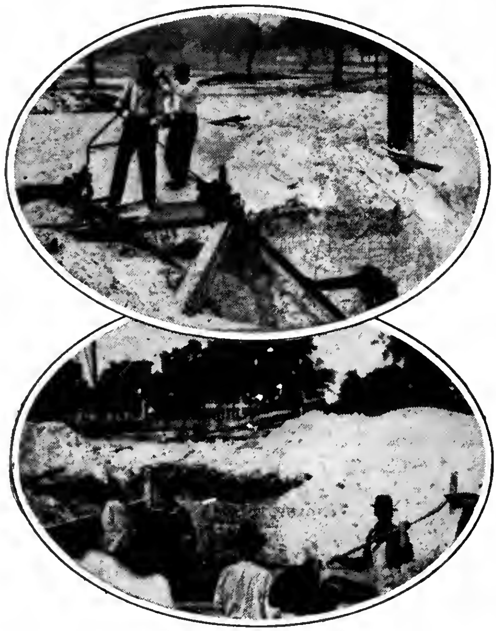


PALMS AND WIRELESS AT KEY WEST

The palms hid the masts, but the station and its buildings took up an entire block. The insert at the right shows Dr. De Forest as he looked when he was doing the installation at Key West

keen pleasure and relief. You radio fans who enjoy making your own sets and revel in the thrill of "hearing results" for the first time, can perhaps appreciate to a degree the sensation that was ours that evening.

From this time on "PN" worked perfectly, and it was not long before we were heard by distant Northern stations.



ALL IN THE DAY'S WORK

Here are the laborers pumping out water from the "ground excavation" at Pensacola to enable the diggers to get at their job of making a place for the large copper ground plate and below, the gang of diggers shovelling sand for the "ground" excavation at Pensacola. Some of them had to work waist deep in the cofferdam. The peculiar character of the ground connection here led to some unusual and very discouraging difficulties

KEY WEST GETS A STATION

COURAGE soared. It was time for another "forward march!"

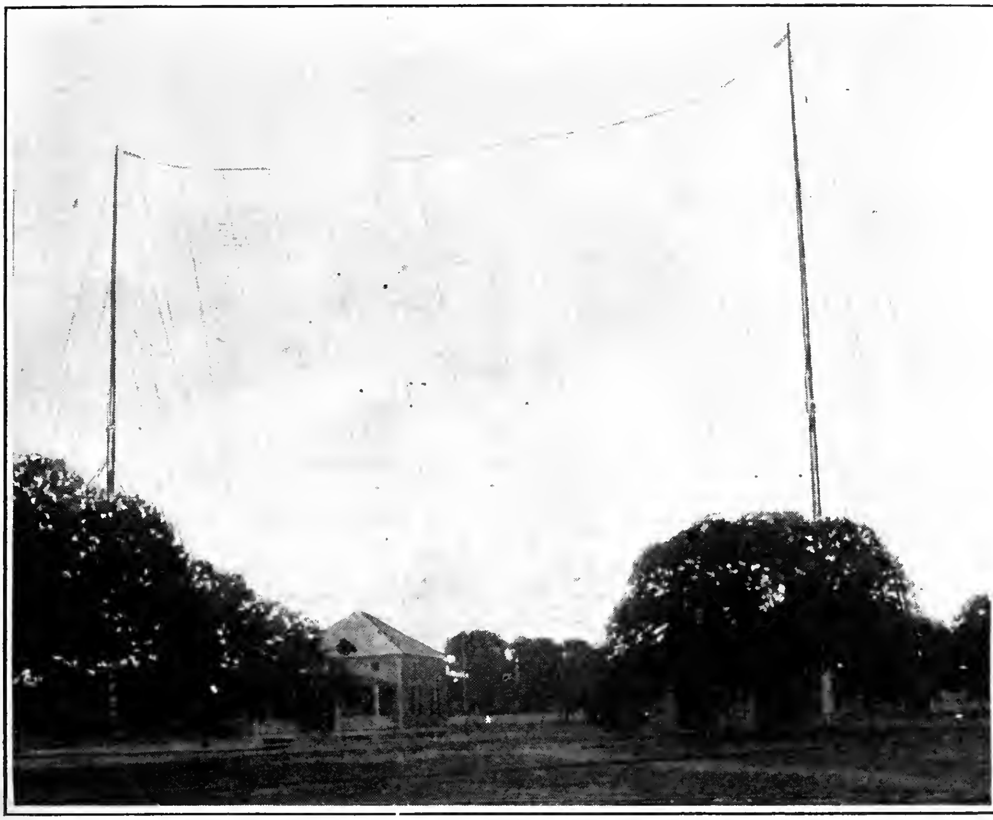
Leaving the Pensacola station in charge of the Navy wireless operators, I departed for Key West, overland, by way of Tampa, and thence by steamer. Even if I had not taken a snapshot of it, I should still be able to visualize the primitive engine that went ambling leisurely from Pensacola to Tampa, an engine of the "diamond stack" wood burning type. About every twenty-five miles cords of three foot stove wood were loaded on the tender, to be consumed during the next twenty-five miles with much belching of smoke that, compared to coal smoke, was a grateful odor.

Arriving at the Tampa docks just before noon, I had lunch, after which I found my finances reduced to exactly five cents. My boat ticket included meals, but the boat was not to leave until evening. There was nothing but a railroad yard at the Tampa docks, and the city itself was ten miles distant. So, with insufficient carfare to "go to town" there was nothing to do during the long afternoon but to watch the fish from the dock. It did not occur to me to mourn over being broke, for, during those early days of wireless, being broke was the usual condition with all of us, and being flush meant knowing where next month's rent was coming from. And it was worth it, the fight, the privation, the anxiety. And even if any of us had had it in us to weaken, it would have been impossible with De Forest always at the helm, an inspiring leader.

I found him at Key West in his wireless station set in the midst of a picturesque tropical grove. Cocoanut, banana, and palm trees completely surrounded the station and the living quarters of the wireless crew. So far as climate and scenery were concerned, this island was an ideal place in which to live. But the restaurants were exceedingly poor. The only appetizing food was rice and hard rolls. Although fish was abundant, no one seemed to know how to cook it. When our work was going fairly well (comparatively speaking) we felt rather disturbed about this inadequate food supply. But when trying to solve seemingly unsoluble problems, we scarcely knew whether we ate or not.

Spread majestically over the trees of the grove that surrounded the station was the huge triangular cage antenna consisting of 45,000 feet of wire, suspended from three equi-distant masts, two hundred feet high. The radio fan who has used seven stranded phosphor bronze wire for antenna purposes knows how stubborn and kinky it is and how difficult to handle. Think, then, of the difficulty of this antenna installation owing to the density of the tree foliage and the prevalence of high winds.

Many improvements in the wireless apparatus were noted at this station, and the quality of the spark at "KW" (as it was then called) was better than hitherto heard. Most notable of these changes were new ideas in receiving tuning devices. We made a definite endeavor to overcome the incessant static.



STATION PN
The De Forest Station at the Warrington Navy Yard, Pensacola, Florida

In my diary, under date of April 16, 1905, I find a notation of an experiment we carried on at this Key West station with an *incandescent lamp for the purpose of eliminating static.* In these tests we used bulbs of various voltages and watts in conjunction with coils and condensers. The results were unique but not definite.

This was two years *before* the famous "audion" bulb was invented by Dr. De Forest. Little did we know how closely we were stumbling at the door of the "wonder lamp" that was destined to revolutionize wireless and make radio broadcasting possible. Had we gone a degree or two farther we might have a different story to tell here.

Evidently the doctor had become tired of "pump handling" "D" signals as was done at St. Louis, day after day, because here he had devised a mechanical contrivance operated by clockwork, which sent out the "dash-dot-dot" "D" signals incessantly, without manual effort.

My stay at Key West was short, as it was now time to begin operation at Guantanamo Cuba, where the third station of the group was to be erected. Again, I started forth with high hopes, believing that the worst of my experiences with wireless were behind me. As it turned out I was going straight into a work that called for wholly unforeseen and difficult engineering feats and the most crucial physical endurance test of the entire contract.

How success was finally accomplished after eleven months of hardships and disappointments is a story in itself which will follow.

(The next article in this series will deal with the experience of these radio pioneers in Cuba)

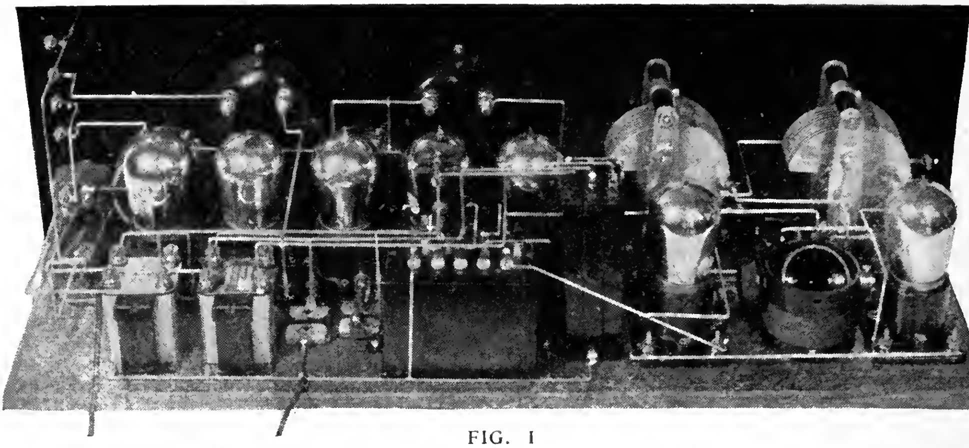


FIG. 1

The rear view of the seven-tube "super". The photograph shows what an excellent layout can be secured using a standard 7 by 24-inch panel. The small balancing condenser is shown between the two variable condensers

Revamping the Silver Super-Heterodyne

Complete Instructions and Discussion on Changes Necessary to Adapt a Dry-Cell Straight "Super" for Storage Battery Tubes—A Complete How-to-Build-it Article Describing a Super-Heterodyne Which Produces Remarkable Results

By McMURDO SILVER

IN THE October, 1924, RADIO BROADCAST an article appeared by Mr. Silver, describing a super-heterodyne that operated on 199's, had remarkable selectivity, and could be assembled from standard and easily procurable parts. In this article, Mr. Silver has answered a demand for a super-heterodyne of the same qualifications to operate with storage battery tubes. Experienced constructors, and those not so experienced will readily appreciate that this "super" is well worth the time necessary to build it.—THE EDITOR.

SINCE the publication in the October RADIO BROADCAST of the description of the portable super-heterodyne receiver using dry-cell tubes and self-contained batteries, the writer has been swamped with letters from fans asking all manner of questions, and reporting results far in excess of what they had expected from the set.

Reports have come in from all sides, telling of phenomenal DX reception with this set and its exceptional selectivity and quality of reproduction, both from seasoned experimenters and from builders who had no previous constructional experience. One log made by a man totally unfamiliar with radio who had built the set, listed thirty-three stations heard in one night, with loud speaker volume on an 18-inch loop. This was the second evening he had operated the set in his home, in a thickly populated Chicago residential district, surrounded by steel frame buildings. Another report came from a man who had built seven different super-heterodynes in an endeavor to get selectivity and DX reception in his home, located, within a radius of five miles of a number of powerful broadcasting stations. Suffice to say, that he finally found what he had been hunting

for as he was able to report during the first week of operation three Pacific Coast stations received with loud-speaker volume.

Several of the sets, located within five blocks of WQJ and WEBH in Chicago, have tuned-out these two stations and brought in WGY in Schenectady and WOS in Jefferson City, with loud-speaker volume on a small loop. The separation between WGY and WEBH is ten meters, and between WQJ and WOS, seven meters. It is also possible to work through WLS on 345 meters to WBZ in Springfield on 337 meters. Some builders have reported five Pacific Coast stations in one night, through the locals. An experimenter in Delhi, New York, reported loud-speaker reception from KGO in Oakland, California, several times in one week, as well as stations all over the country.

Last but not least, Captain Irwin of the RADIO BROADCAST COVERED WAGON reported from Las Vegas, New Mexico, hearing both east and west coast stations with loud-speaker volume, operating the set right in the COVERED WAGON. He advised that dead spots did not seem to exist when the set was in operation, and that it was the most selective outfit he had ever operated. This will be realized when it is understood that a one half degree movement of both dials will tune from WSAI, Cincinnati, to KGO, Oakland, with a silent spot between them.

Practically all of the letters received about this set have asked questions which might be summed up as follows:

1. How can storage battery tubes be used?
2. How can the set be enlarged to make an easier wiring and assembly job?
3. Can resistance-coupled audio amplification be used?
4. How can a stage of tuned radio-frequency amplification be placed ahead of the first detector?
5. How can voltmeters be incorporated for A and B battery voltages?

THE NEW MODEL

IN RESPONSE to these many questions a larger model of the portable "super" was designed, which for ease of reference, will be called the laboratory model. This set is 24 inches long and fits in a 7 x 7 inch cabinet. It may be used with any type of tube now on the market, or various combinations of types, and will permit of as many refinements in the way of extra high grade material as the builder may desire to incorporate.

The portable set has already proved to be one of the most thoroughly satisfactory and fool-proof "super" designs ever presented to the public, and the larger laboratory model is even superior to it in the matter of volume when 201-A or DV-2 tubes are employed. This model retains all the desirable features of the portable, but because it is spread out more it is somewhat simpler to construct and is recommended to the fan who is not interested in building a small, self-contained outfit.

The results to be expected will be somewhat better than those experienced with the portable set. In the suburbs of Chicago the laboratory model will bring in the east or west coast broadcasting stations on a small 18-inch loop with slightly greater loud speaker volume than the portable. On locals the use of the larger tubes gives considerably more volume. As for selectivity, stations such as WHN, WGY, WBZ, WFFA, WOAW, KGO, and many others could be brought through while

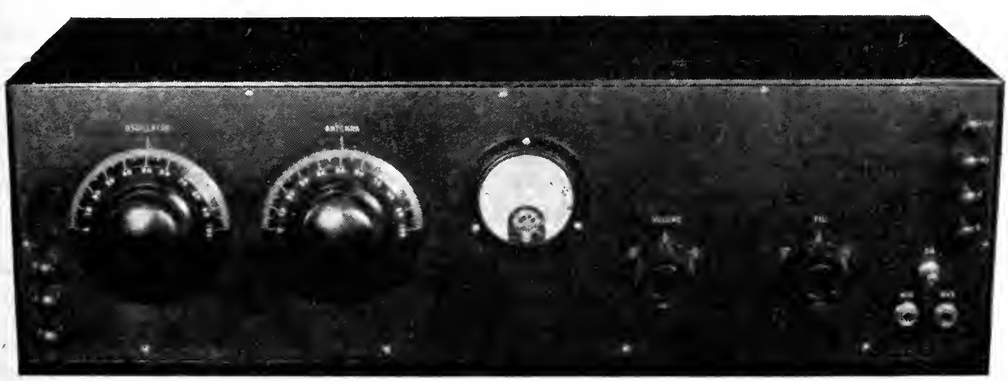


FIG. 2

Shows the front panel view of the storage battery-operated super-heterodyne. The small balancing condenser used in the receiver is not shown in the photograph

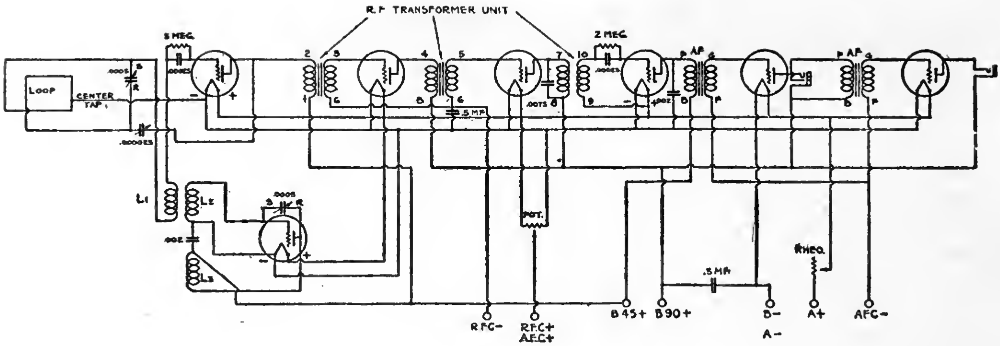


FIG. 3
Schematic circuit of the seven-tube super-heterodyne

four or more of the powerful local stations were operating within a radius of twenty miles. The tuning of the set is so sharp that a fraction of a degree will throw out out-of-town stations, and a movement of two or three degrees on both dials will throw out locals completely.

ANY TYPE OF TUBE MAY BE USED

THIS laboratory model may be built for use with any tubes on the market and if the builder already possesses WD-11's or WD-12's, which heretofore have been considered unsuitable for "super" use, they may be used in this design satisfactorily. The tube combination may employ either WD-11's, WD-12's, UV-199's, DV-3's, UV-201-A's or DV-2's either throughout the entire set, or as detectors, oscillator or intermediate amplifiers. In any case the use of 201-A's for audio amplification is advisable in order that full advantage may be taken of the volume developed by the set. If volume enough for home use is all that is desired, 201-A's need not be used, however.

A front view of the laboratory model is given in Fig. 2, which, however, does not show the small balancing condenser brought out to the panel. Meters are not absolutely necessary, but if the constructor desires to add them they are very convenient for checking up the battery voltages. Fig. 1 is a rear view of the set, showing the placing of the instruments and the general lay-out. Figs. 3 and 4 give the circuits, both pictorial and schematic, and it will be seen that they are practically the same as for the portable. The panel lay-out is in Fig. 5.

Certain refinements have been added in this larger model, such as the addition of battery binding posts, a filament switch, the location of the balancing condenser on the panel, and the voltmeter, which need not be employed unless desired.

Below is a list of parts used:

2 Silver .0005 Low Loss Condensers.
2 4" Moulded Dials—Tapered Knobs, preferably vernier type such as Apex or National.
1 Howard 7-Ohm Rheostat.
1 Howard 200-Ohm Potentiometer.
7 Insulated Top Binding Posts, Eby or similar.
1 Single circuit-closed Carter 102-A Jack
1 Open circuit Carter 101 Jack.
1 Silver R. F. Transformer Unit No. 401.
1 Silver Oscillator Coupler, No. 101.
7 Benjamin Spring Sockets.
2 Thordarson 3 ½ : 1 Audio Transformers.
1 On-off Switch.
3 .5 mfd. By-pass Condensers.
2 .00025 mfd. mica Condensers with Leak Clips.
2 .002 mfd. mica Condensers.
1 .0075 mfd. mica Condensers.
1 .000045 mfd. balancing Condensers.
1 .5 Megohm grid leak.
1 1 Megohm grid leak.
7 x 24 inch Panel.
7 x 23 x ½ inch Oak Base Board.
Bus-Bar, Spaghetti, Screws, Nuts, Solder, Lugs, etc.

ACCESSORIES:
1 Loop with Center Tap.
7 Tubes
2 4½-volt C Batteries.
A Battery—6 volt.
B Battery—90 volt.
Phones, or Loud Speaker, and Plug.
1 7 x 24 x 7 Mahogany Cabinet.
Tools needed: screw driver, pliers, soldering iron and hand-drill with drills and counter-sink.

Other parts may be substituted for those recommended in the list, but the constructor should be very careful to see that they are of first class manufacture and in every respect of as good quality as those recommended.

If UV-201-A, DV-2, UV-199, or DV-3 tubes are used, the Benjamin spring sockets will work in very nicely. These sockets absorb all vibration and eliminate almost entirely the ringing noise often experienced with such tubes. In addition, these sockets are excellent from an electrical and mechanical standpoint.

If standard 4-inch dials are used on the condensers, they can be tuned satisfactorily either by means of a pencil with an eraser rotated against the edge of the dial and the panel, or by tuning the dial with the fingers on the outside edge instead of on the knob. If vernier dials are used, the Apex, which is geared about 10 to 1, is extremely satisfactory and is to be recommended. The Eztoon is also a good dial, except that the vernier action covers only a few degrees, after which the entire dial must be rotated and the vernier re-adjusted. Any other good standard vernier dial without "back-lash" or play in it will be satisfactory.

Jefferson No. 41 transformers may be used in the set although Thordarson $3\frac{1}{2}$ to 1 transformers seem fully as satisfactory as the Jefferson.

The Thordarsons may be used in either $3\frac{1}{2}$ to 1 for both stages or if a very great volume is anticipated a $3\frac{1}{2}$ to 1 in the second stage and a 2 to 1 of the new type in the third stage.

For details of the construction of the set. the reader is referred to the unusually complete construction article on the portable set in RADIO BROADCAST for October, 1924. Methods of construction in both sets are quite similar.

HINTS ON ASSEMBLY

ALL PARTS are placed on the baseboard and panel, and should be located according to the photographs. After the panel has been prepared, the proper parts should be placed on it and the sub-base screwed in position. The parts to go on the sub-base should be placed in their proper positions, and their locations marked, care being taken to see that they are so situated that the wiring will be easy and that tubes will not strike meters, etc. or the location of any parts on the sub-base conflict with parts on the panel.

All wiring that it is possible to do on the panel should be done before the panel is attached to the sub-base on which the sockets,

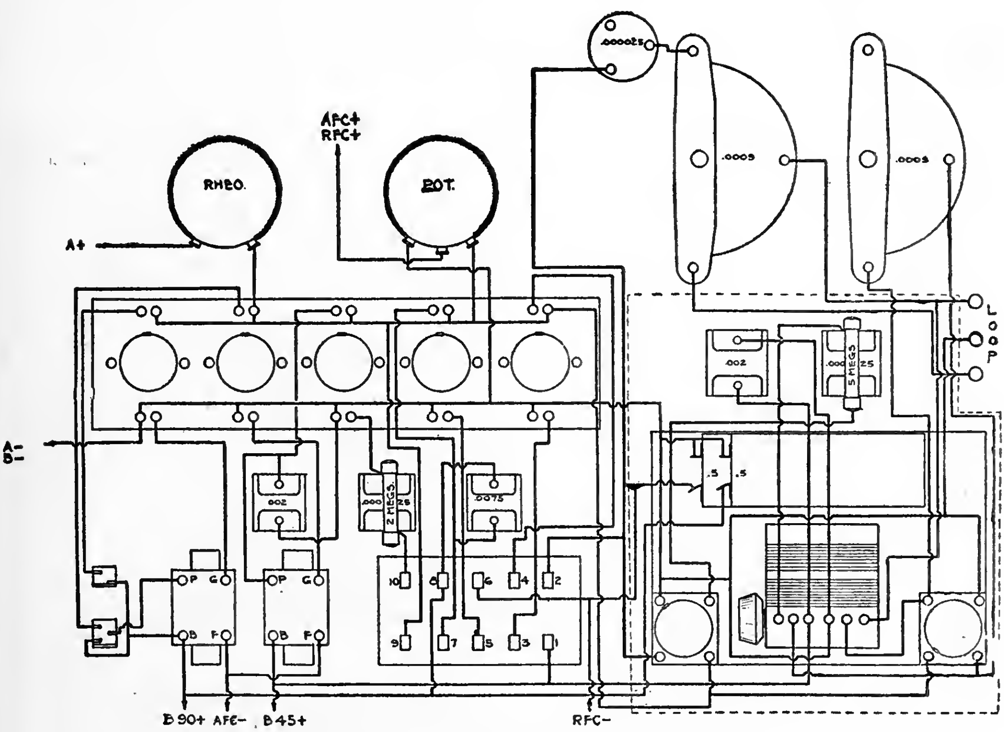


FIG. 4

A placement diagram of the units in the receiver

transformers, etc. have been mounted. Likewise, all possible wiring should be put in place on the sub-base before it is finally screwed to the panel. If this is done, only a few leads will have to be run from the panel to the baseboard and the wiring will be found quite simple and easy. The wiring may be done with bus-bar, straightened, bent at angles and soldered to lugs fastened to the instrument binding posts, or it may be done with flexible magnet wire covered with spaghetti, as described in the October article.

A C battery is used on the intermediate amplifier tubes as well as on the audio amplifier tubes. For UV-201-A's this C battery will vary between 3 and $4\frac{1}{2}$ volts. The same values will hold for UV-199 or DV-3 tubes, while the C battery value for WD-11's, or WD-12's will range from $1\frac{1}{2}$ to $4\frac{1}{2}$ volts. In each case the C battery is connected with its negative terminal to terminal 6 of the radio-frequency transformer unit and its positive lead to the center contact, or arm of the potentiometer. The audio amplifier C battery is connected with its negative lead to the F terminals of the audio transformers and with its positive lead to the minus side of the filament line. The C batteries may be located on the right hand corner of the base board inside the cabinet. If a high value of C battery is used on the intermediate amplifier, the potentiometer will have no effect on the volume of the set and a low enough voltage to permit of the potentiometer volume control should be used.

It will be noticed in Fig. 3 that three by-pass condensers are used, each of $\frac{1}{2}$ mfd. One is connected across the 90-volt B battery, one across the 45-volt B battery section and one from terminal 6 of the radio-frequency transformer unit to the minus side of the filament. The cans of these condensers are soldered together, and with the cans of the audio transformers and the radio frequency transformer unit, are grounded to the negative side of the filament. This is very important; instability of the set may be due to the failure to ground all of these cans.

If meters are to be used in the set, a voltmeter with a maximum scale reading of from 6 to 10 volts may be connected directly across the A battery terminals of the set to indicate the A battery voltage, or across the filament terminals of one of the tube sockets to read the filament operating voltage. This latter is the preferable position as it will permit operating the tubes at their best point, and resetting of the rheostat to the same value each time the set is used. A milliameter in the plate circuits of the tubes is of little value; a B battery voltmeter would be preferable. The B battery voltmeter may be connected directly across the B battery or it may have its negative terminal connected to the negative B terminal of the set and its positive post brought through the resistor to the center arm of a small single-pole double-throw switch. If one contact of the switch is led to the 45-volt B post and the other contact to the 90-volt B post it will be possible, by means of this switch, to throw the meter across either the 45- or 90-volt battery sections at will. If a double range voltmeter is employed, a small switch can be used to throw it from the A to the B battery. The details of these circuits are given in Fig. 6.

The advantage of bringing out the balancing condenser to the panel is that it permits maximum sensitivity to be obtained at every wavelength. If the balancing condenser is set at one fixed value, it will have to be at a point where the first detector tube will not oscillate at the shortest wavelength to be received. At the longer wavelengths the value of balancing condenser may be increased slightly with resultant strengthening of

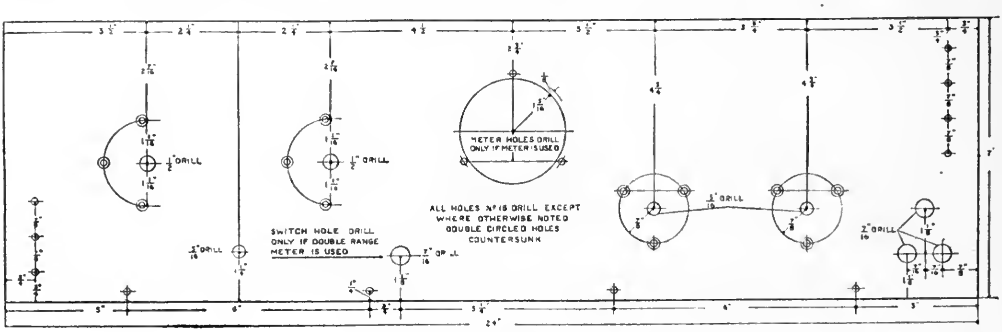


FIG. 5

The panel layout

signals. This control is not critical except that if too high a value of condenser is used the first detector tube will oscillate and become unstable. The condenser may be located above and between the two tuning condensers on the portable model also, if it is desired to take advantage of the full amplification possibilities of the set by means of this one additional, but fairly non-critical adjustment.

Binding posts may be located on small bakelite strips on the sub-base so that they will not appear on the panel. This will add somewhat to the appearance of the set if it is to be used in a permanent installation.

WIDE LATITUDE IN ASSEMBLY

THE assembly can be changed to meet any individual conditions of height, depth, or length, such as might be imposed by a phonograph cabinet. The amplifier assembly should not be changed, but the oscillator coupler and first two tubes may be moved up against the panel between the two condensers, which will have to be located farther apart. The entire amplifier section may then be shifted behind this portion of the set, which will make an assembly 12 to 15 inches long and 8 to 10 inches deep. (See Figs. 6, 7, and 8 of the article on the portable receiver.) It is also possible to locate the amplifier section above the condensers and first two tubes. The size would then be approximately 10 to 11 inches high, 12 to 15 inches long, and 6 to 7 inches deep. These variations are only suggested where the constructor wishes to meet particular space requirements, and feels confident that he will be able to work out the changes satisfactorily.

TESTING AND TROUBLE SHOOTING

Filter Condenser: The value of the condenser across the RF unit terminals 7 and 8 will vary between .0075 and .01. It is best to start with .0075 and then build up to .01 by adding .0005 and .001 condensers in parallel with the .0075 condenser. The best value will be where the oscillator dial reading is sharpest on a comparatively strong local signal. The proper number of condensers may be bolted together with machine screws and nuts and soldered in position on the wiring.

Grid Leaks: For 201-A tubes the grid leaks should be from ½ to 2 megohms for the second detector. One megohm is satisfactory. A grid leak from 2 to 5 megohms should be used for the first detector. The higher value is preferable. Grid leak values for 199 tubes are given in the October, 1924, article and the same values are correct for DV-3's. For WD-11's or WD-12's they will be approximately the same as for 201-A's.

Filament Returns: In the portable receiver, the first detector grid return, or center tap of the loop is shown going back to the negative side of the filament, and for the second detector, terminal 9 of the can leads to the plus side

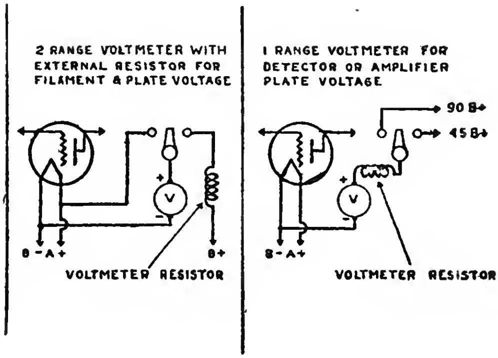


FIG. 6

Wiring details of voltmeter which can be used with advantage in the super-heterodyne

of the filament. In the laboratory model both these returns are shown to the negative side of the filament. It is not of very great importance which connections are followed out, although it would be advisable to keep all returns, including those of by-pass condensers, on the negative side of the filament line.

Overloading: Due to the extreme amplification, about 55 per stage (voltage) with 201-A or DV-2 tubes, developed in the intermediate amplifier it is sometimes possible to overload the set on strong local signals. This may be overcome by some of the suggestions offered in regard to the portable super-heterodyne or by connecting grid leaks of $\frac{1}{10}$ to ¼ megohms across the radio-frequency amplifier tubes from grid to plus or minus filament.

Potentiometer Control: In the case of 201-A, DV-2, UV-199, or DV-3 tubes, the potentiometer control will probably be satisfactory in that the volume of stations may be reduced by retarding its arm toward the positive side. If this is not possible, decreasing the value of C battery on the RF tubes will remedy matters. On WD-11's or WD-12's, good control will be difficult to obtain and the C battery will have to be set at the lowest value commensurate with good

signal strength in order to obtain any volume control at all on the potentiometer. This is because in the case of 201-A's, the voltage variation across the potentiometer is from 3 to 5 volts and with 199's from 2½ to 3 volts, whereas with WD-12's, the variation is only about 1 volt.

Filament Rheostat: If one type of tube is used throughout the set, a single rheostat for all tubes is sufficient. This should be from 6 to 7 ohms for any of the standard tubes. If 201-A's are used only in the audio stages, their positive filament leads will have to be brought out independently, when other types of tubes are used up to the audio stages The filament adjustment on the 201-A audio tubes may be made by means of an extra rheostat or by means of a small resistance unit placed inside the set and adjusted once. The filament current of the audio tubes is not critical and when once adjusted may be left fixed. If the 199's are to be operated as the first five tubes in the set in conjunction with 201-A's on a 6-volt battery, the rheostat resistance for these five tubes will be from 15 to 20 ohms. If WD-11's or 12's are used for the first five tubes, they should be operated either on a 6-ohm rheostat lead out to a separate A-plus binding post and then to a 2-volt tap on the storage battery or to a separate A battery. If they are to be operated directly from a storage battery supplying the 201-A's, the rheostat resistance will be about 10 ohms. In both the case of the 199's and WD-12's, run directly from the storage battery, the rheostat used with them should be just barely turned on, as if it is cut all out the full 6 volts will be applied directly to these tubes with disastrous results.

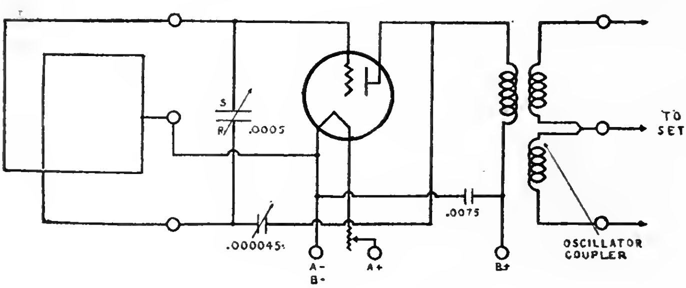


FIG. 7

How to add an additional stage of radio-frequency amplification to the "super". Another oscillator coupler, tube, socket, rheostat, and variable condenser is necessary for the construction of this separate unit, which should not be attempted except by the radio constructor who is expert at tuning the super-heterodyne because the additional radio stage sharpens the tuning greatly

Volume Control: The volume of the set may be controlled by the potentiometer, operated in conjunction with the rheostat. The potentiometer might be entirely omitted and the volume controlled by the rheostat only. It will be found that if the full amplification of the set is used on local signals, a slight amount of distortion may be evident. With volume enough to be heard all over a 40 foot square room no distortion will be experienced. In any event it may be controlled by proper rheostat and potentiometer adjustments. It has been found possible to operate 201-A tubes with as little as 3½ volts on the filaments with perfectly satisfactory results.

Location of Rheostat: Tube manufacturers recommend that rheostats be placed in the positive filament lead of the detector tube and in the negative lead of an amplifier. The reason for this change is that in the circuits shown in the tube data sheets an endeavor is made to use the voltage drop across the rheostat for grid biasing purposes. If a separate C battery is used and no endeavor is made to utilize this voltage drop across the rheostat, it is of absolutely no importance which filament lead the rheostat is connected in. It is always advisable, however, to keep it out of the lead which is a common B battery return. The common point in these sets is the negative. For these and other reasons it is shown in the positive filament lead, while the on-off switch is in the negative lead.

Plate Voltage: The set will operate satisfactorily with as little as 45 volts on all tubes, but the C batteries will have to be readjusted if this voltage is used. Varying the detector and oscillator plate voltage from 22 to 45 may sometimes improve reception slightly, and decrease consumption a small amount. The current consumption using 201-A's on 90 volts is twenty milliamperes or less, and in using 199's from 14 to 15 milliamperes.

If it is desired to add resistance-coupled amplification to the set instead of transformer-coupled audio it may be done by using the amplifier circuit given in Fig. 8. This shows two stages, which will give not quite the

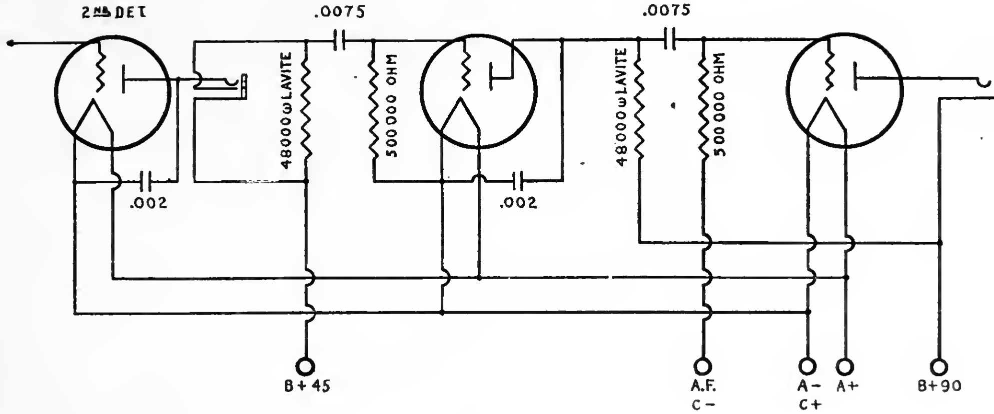


FIG. 8

Two additional stages of resistance-coupled amplification may be connected in place of the ordinary audio-frequency amplifier specified in the circuit

volume of two transformer-coupled stages. This is of no very great importance, however, since the volume obtained from the set is in practically all cases, very much more than will be needed for good loud-speaker operation.

It is suggested that lavite resistances of about 48,000 ohms be used as the plate-coupling resistances with grid leaks of from ¼ to 1 megohms. It will be advisable in this case to leave out the jacks in this amplifier and use either the detector output or the full two-stage amplifier output, as is shown in the figure. In this case, a C battery will be necessary only on the last audio stage, where it should be of approximately 4½ volts. This is because the effective plate voltage on the first stage is only about 30 to 40 volts, whereas the effective plate voltage on the last stage is very nearly up to the full 90 of the B battery. This will be made clearer when it is realized that a 48,000 ohm resistance is in the plate circuit of the first audio stage which cuts the B voltage to approximately ⅓ that of the full plate potential. Only a loud-speaker or a pair of phones is in the plate circuit of the last audio stage with the result that practically all the B battery voltage is applied directly to the tube.

SHORT WAVE RECEPTION

THERE is a growing interest in a really sensitive receiver for operation on the new low broadcasting wavelengths in the neighborhood of 100 meters.

The wavelength range of the oscillator used is about 150 to 550 meters, which is more than ample for the entire broadcasting wavelength band. This oscillator range will permit reception over a range of from slightly below 150 meters to about 600, by using the lower heterodyne point at the upper end of the range, and the upper points at the lower end of the range.

It is also possible to use a harmonic of the oscillator to perform the heterodyne function. If the first harmonic, or half the wavelength of the oscillator is used, it means that the range of the oscillator, using this harmonic, would be from below 75 meters to nearly 300 meters. If it is desired to receive a 100 meter signal, the oscillator dial may be set at either of its points where a 200 meter station may have been heard. Then the harmonic will bear the proper relation to the 100 meter signal to create the necessary beat with it. This, of course, is general, but it indicates how the set would be operated.

The loop circuit would have to be changed for this work, the loop being cut to about four turns. It may be rather difficult to employ the split loop feature at these waves also. If an antenna is used, the coil to replace the loop may consist of about 20 turns of No. 16 or No. 18 DCC wire, on a three or four-inch form. The antenna coil should contain three to eight turns, depending upon individual conditions.

If a set is to be built for short wave work only, the oscillator coils could be wound with fifteen turns each in L2 and L3, and about six or seven turns of heavy wire in L1.

SHORT WAVE R. F. AMPLIFIER

UNDER certain conditions the experienced fan may find it desirable to add additional R. F. amplification to either of the receivers. A condition which would

justify this would be where the atmospheric noise was not very great and where it was desired to obtain the very limit that could be gotten from a receiving system. Or, it might be that the receivers were poorly located, so far as collecting sufficient energy for their operation is concerned, yet the noise level might be very low. In either of these cases it would be possible to add a stage of R. F. amplification before the first detector tube, which would involve but one additional tuning adjustment. This adjustment would be comparatively sharp and the addition of this amplification is not recommended until the builder has operated his set for some time and is entirely familiar with its operating characteristics. This is because with three tuning dials the set would be so sharp that it would be extremely difficult to tune it without knowing where at least two of the dials should be set for a given wavelength.

The circuit for this amplification is given in Fig. 7 and the only additional equipment necessary to construct it would be an oscillator coupler, as described in the previous section, the tube with its socket and rheostat, the tuning condenser, and a balancing condenser.

The entire amplifier could be housed in a small box which would go at the loop end of the set with three binding posts to connect it to the set and three binding posts for the loop. It would also be necessary to bring out posts for the A and B batteries as shown in the drawing.

It will be seen that this circuit is practically the same as that of the first detector, except that the grid condenser and leak and oscillator coupling coil have been omitted.

In the plate circuit of this R. F. tube, the coupling coil of an oscillator coupler is connected. The stator windings of the coupler are brought to three binding posts on the panel of this unit and are in turn connected to the three binding posts intended for the loop on the set itself. The oscillator coupler then performs the function of the R. F. transformer. Its two stator coils with their center leads joined, form the secondary circuit, the coupling coil acting as the primary. The balancing condenser in this case is not critical as in the first detector circuit of the super and may be set practically all the way in without oscillation occurring in the R.F. stage. This condenser acts almost entirely as a neutralizing condenser, its purpose being to sharpen the tuning of the loop connected in the R. F. stage and to prevent oscillation.

The same batteries may be used for this unit as are used for the set itself, and any standard type of tube may be employed in the circuit.

FORCE OF RADIO HABIT

The Doctor: "H'm! that's strange, Cuba ought to be on now!"

STATIC DAYS AND NIGHTS

The Boredom of Ranch Life is Now Broken by Radio

Word and Pen Pictures of the E-Bar Ranch

By Remington Schuyler

"STATIC" describes perfectly the evenings on the old ranch in South Dakota. So *static* were our evenings that in desperation we turned in along about nine o'clock of a winter's evening, bored to death with each other.

The same old faces, stories, and magazines grew terribly dog-eared. We knew the magazines from cover to cover. We knew the advertisements with the same close intimacy. We knew every yarn of the other fellow's and every "funny story." Dynamite is "static" till you wallop it. It only needed some slight wallop to start something in the close harmony of our bunk-house. It was a desperate time. You can't forever talk horses, cattle, and women.

Living the same life, doing the same things, day after day atrophied our brains. Our conversation moved sluggishly in deeply worn channels, all too familiar and threadbare.

The nearest ranch, Isaac Battleyoun's, was fifteen miles over across the broken buttes of the Key-a-pa-ha. Ike had a wax cylinder Edison; a Steinway, a pipe organ, and a daughter who could certainly play. At times my bunkie and I would ride over and sit in on some music. It was not often, for by sundown we were dog-tired, and thirty miles, what with the drifts, was no great sport after a fourteen-hour day.

We were building up the E Bar. Our days were long and full of toil. Four A. M, when it was still dark and bitterly cold we "came alive," bustled into our frozen, board-like clothes and got out and going. There were seven of us. Six cow-hands and Bob Emory, our genial foreman. Into the frosty darkness, one of us would ride over the drifted prairies and round up the pony herd and work horses. By lantern light another chopped wood. A third pumped water for the stock and calves in the pens. The rest busied themselves pitching hay or building the board corral and branding chute. At six o'clock and barely dawn we were heartened by the familiar ring of the lustily beaten frying pan and the welcome whoop, "Come and get it." In a ravening pack we scrambled to be first into the grub house. This nine by nine end of the log cabin was also kitchen and washroom.

Hustling in the door, one slopped a dipper of icy water into the tin basin—hurriedly soaped and washed face and hands and slicked one's hair. Then on to the grabbing match at the oil cloth covered table.

At the round corral a lively scene followed. The pony herd led by the wise old bell mare had been driven in. With saddle rope dragging we stealthily stalked our horse for the day. If you were crafty enough, to mislead the horse you were after into thinking you were after some other one, then a sudden swish of the throw rope and you had your mount for the day.

Saddles were slapped on, latigoes made snug and we were off about our several businesses. Some rounded up and counted the scattered herd and threw them back on the range, then looked for strays or cattle that had "gotten down." Others set out with running gear and teams to haul logs from the "breaks"

of the Little White. The logs were needed for our bunk house which was slowly rising alongside the original ranch-house.

At noon and again at six we went through the same washing rites and ate the same grub. After supper "while we were resting" as Bob used to say, we squared and wrestled into place a few more logs on the bunk-house walls.

During the fall, the tent which "The Kid" and I slept in had been the gathering place. Now that winter was seeping down from Medicine Hat it had grown too frigid to be pleasant for gossiping.

Our new bunk-house was complete, so we gathered the clan there. Pipkin and Ambrose had one room, The Kid and I the other. Our room had more bunks and a stove. The Kid's mother had sent over some curtains and do-dads that added to the coziness.

THERE was Pipkin—an ex-cavalry man, a genial, hard riding good scout. He had come to us in the summer. "Pip" was down on his luck with a badly infected finger and arm, but with a zest for work. After he arrived we had taken turns as surgeons. A liberal use of gauze, bailing wire and tobacco quids had nursed him back to a normal use of his hand and arm, and an intense desire to work. His army stories and ditties had given us quite a few thrills and furnished entertainment. But he was running dry. We knew his Sergeant McGillicuddy tales almost perfectly.

Ambrose, nick-named "Old Nick," was a dirty, unshaven, unbathed rascal. He had a flow of language which was an undammed stream of obscene profanity. He couldn't even ask for a smoke without G——D——ing it. And yet his folks were sturdy pious New Englanders. The daguerrotypes of his parents and grandparents showed fine stock, dependable citizens. He had slipped from his earlier snubbing post and was a disgusting specimen. A bath with him consisted of squirting water on himself and scrubbing white spots with a sock. If ever his spots seemed in danger of overlapping he would quit disgustedly, muttering he was getting "too —— —— particular". Then another month would add its grime and grit unmolested.

"BOB"

"The Kid" was young, handsome, well knit, the son of a teacher in the Indian day schools; raised on the prairies, a good cow hand and rider. But his mind dwelt constantly on new conquests to be made and the remembrance of former ones. A year as a fireman on the Missouri and Elkhorn; another with the Express Company, these were the only times he thought he had really lived. They were his only vivid experiences. He constantly pined for what he longingly called God's City—Chicago.

For my part they knew all I could tell them of my native state, Missouri. My camping experiences down in the Ozarks among the mountain people were the only bits of conversation that got by. So I would plunk my old guitar and sing Negro camp meeting songs and the latest popular hits I had learned before leaving St. Louis. "Goo Goo Eyes" "Under the Bamboo Tree" and such like.

The two Indians were just so much smoky blanketed background. They silently rolled and swiftly smoked cigarettes. Like most Indians who smoke they resembled an engine starting up. A series of short sharp puffs, then a pause. Another series and then that cigarette was about done.

Often I tried to draw them into the conversation. But "The Kid" and Ambrose thought only of them as "damned Injuns," and barely tolerated them in our circle.

Eagle Horn Dog was a noted singer of the Sioux. That is, he made new songs and knew all the old ones. He had a fine voice and loved to sing. Sometimes I could get him to favor us. It was stirring to listen as he thumped the bunk edge with a quirt and sang "Sitting Bull's Defiance" or "Go You to War?" or "Horses I am Seeking." Last year when I broadcast my western experiences from WEAF, I sang some of the songs which I had learned from Eagle Horn. Eagle Horn is gone to the Happy Hunting Grounds. Enlisting immediately when we entered the World War, he

went across with the First Division. He was among the first to fall.

Except for an occasional grunt, "Was-Tay" (good), "Waw-wee" (the Hawk) never made himself prominent. He seemed to be glad of the warmth and the company, but otherwise was merely a blur in the smoky background.

Bob, our foreman, was our best entertainer. He had grown up in the saddle. He had known cattle and horses all his life. He had been in on the last of the buffalo running. In his youth he had drifted over many ranges. He told tales of "The Panhandle," Montana, Idaho, and the "Ute" country near Carson Sinks. The Dakotas were as familiar to him as his own quarter sections. His knowlege of cattle ways and pony tricks seemed uncanny.

When the mood was on him he could recount thrilling experiences in a stilted matter-of-fact way. He had been in Spotted Tail's tepee when Crow Dog had ridden up and shot "Old Spot" as a traitor to the tribe's best interests. A moment later, sharp knives were slicing the tepee to ribbons while stone mauls were smashing the poles down about his ears. The uproar and excitement following the slaying, he told of as if he had been but a guest at a tea party. Yet in actual fact, he barely escaped alive by jumping his horse down a cut bank and riding across a narrow swift river on a one log bridge.

SO FOR a month or two we had good entertainment. But as the snow banked up around our log houses, and blizzard and snow storm followed each other in steady procession, sweeping down on us over hundreds of miles of treeless prairie from distant Saskatchewan, we gradually got worn to a frazzle.

We tried by superhuman efforts to hold the herd from drifting too far with the blizzards, then worked them back on to our range with painful effort, almost carrying in the weakened steers. Now and then we rescued some snow-blind, snow-bound freighter. And again when a windless snowfall had buried even the ridges, we fared forth with the pony herd. All day we let them paw through to the grass and then drove them on to another pawing contest. The cattle herd followed, and once having smelled the grass exposed by the ponies they nosed out a meagre meal. At night the tired hungry ponies were given some hay and then set adrift to shift for themselves.

The prairie wind seldom ceased. All day it buffeted one. The drifts in the gullies smothered any one who got off the ridges. It was struggle and fiendish toil. Then an evening as pictured in the beginning—monotonous in its sameness.

But once a month came a rift in our clouded horizons. *The Rosebud*, a four-page newspaper, printed at the Agency School by Indians would arrive by some circuitous hand to hand route. But bedraggled and mussed though it was, it brought news from the outside world. We had new things to talk about.

In memory I can see Old Bob, leaning back in an old broken backed chair, following the text with one finger and laboriously reading and gloriously mis-pronouncing such interesting items as "John Comes-Out-Holy" has been visiting in Cut Meat with his old friend "Brings-White" or "Bill Bates and Mack Marsten have been out gunning for antelope in the Bad Lands, or "Doug" McChesney, Agency Brand: Inspector, was down near Olaf Nelson's ranch checking up on Olaf's report of too many strays from the settlers down in Nebraska, or perhaps these bits of Agency humor: "The stork has left a new Annuity Baby at Mrs. Chased-by-Bears. Louis Ribideau will have one more papoose by next Annuity Payment Day. Good luck to you Louie. We hope it will be twins."

And so the wonderful news of the outside world dribbled in to us.

Except for *The Rosebud* and an occasional

Where It Drips Boredom

Remington Schuyler, who is well known to readers of this magazine through the many excellent covers he has done for us, spent considerable time among a certain type of real Westerners to whom we all attach a great deal of "romance". And most of us have thought of the life of the cow-puncher and Indian as something resplendently virile and somehow romantic. We think most often of radio in the city or small town and on the farm, but here is a view of what radio is doing in the genuine "open spaces." The sketches accompanying this story were made some years ago by Mr. Schuyler on the ground, and our cover this month shows one of the typical ranch houses in this country with radio holding its new sway.

—The Editor.

"THE KID"

drifting cowboy we had lost contact with the outside. We were thrown so much on each other that it looked like a free for all would be the only safety valve. There was no telephone. "No nawthing" as Bob used to say.

IT IS a winter's night on the old E-Bar in the year 1923. By hard riding I dropped the drifted miles behind and received a rousing welcome as I pulled up at dusk.

The supper is much the same and the old wash basin and dipper still do duty. But the bunch seems changed. Bob is there, grayer and more wrinkled, Pipkin much the same. In old Ambrose there is a marked change. He seems too ungodly meek and thoughtful. He gets through first and disappears toward the bunk house. We follow leisurely and as we come close to the door I notice for the first time a rude antenna on the roof.

"Sh-h" says Bob as I start to congratulate them. "Slip up here and have a look-see at the old cuss."

Through the small window there is Ambrose hunched down in front of a "super-het" set. Through the thin panels of the door comes a voice familiar through all the country. That tough old ex-service man, McNeary, with his grand voice and wonderful imagination telling bedtime stories—and old hard-boiled Ambrose listening-in on the loud speaker. When WOR has signed off we stomp loudly up to the door and bursting in, find Ambrose trying to get WEAF.

At last we succeed and coming over the air is Oskenonton, the Mohawk Singer singing an Indian program. His rich voice and the thump of the water drum comes clearly. At the end he sings "Sitting Bull's Defiance" and one of old Eagle Horn's plaintive melodies.

"Jest like old times ain't it Cinchbuckle?" says Bob. "Can't you jest hearn Eagle Horn a-yowling? I'll tell a man we sure got the world by the tail with a down hill pull."

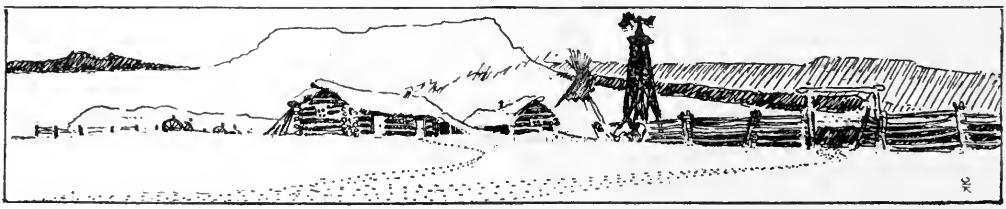
"When these here dinkuses furst came out we didn't put no stock in them," says Pipkin. "But Johnny in at the Agency got one and when we all heered it, why man alive we just cottoned to it."

"We hocked our German silver trappings and we're way behind on the pay, but I'd eat my socks if I had to to jest keep the dinkus in prime shape."

It was funny to hear their remarks about the different performers.

"Why," says Bob, "We nearly bought a vacuum cleaner, after listening to a feller who was 'loco' about it. It do beat all what you can learn."

And so each evening while I was there we had a radio banquet. Gone was the old dismal gloom of snow-bound isolation. A wider world had stalked across the frozen prairies and opened up their lives. They were *living* nowadays and happy. In an old shed they had the wreck of a flivver jacked up. It was Ambrose's job to keep her running enough to store the battery. The three old cronies Bob, Pipkin, and Ambrose still clung to the remnants of the old E Bar doing freighting carrying the mail, and Bob now and then had put in a few years as instructor to the Indians in farming. But the tie that made the old E Bar a rallying point—a home for all of them, was radio.



Notes on Neutralizing the Roberts Circuit

By JOHN B. BRENNAN

RADIO receivers, especially those using the regenerative principle, should not be allowed to radiate energy into space, causing unnecessary interference with other receivers in the vicinity.

In the Roberts circuit, radiation is prevented by the use of the coil N and the condenser connected to the grid of the first tube and the coil N. This coil N, because of its peculiar connection, prevents oscillation in the plate circuit of the first tube, and the condenser, when properly adjusted, should exactly equal the capacity between the grid and plate of the tube. (See Fig. 4). Mr. Roberts describes the theory of this action as follows:

> Whatever alternating voltage exists on the plate of the tube must be due to alternating magnetic flux linking P. But the same flux also links the similar winding N, which is connected the other way 'round, and hence, acting through C, produces an effect on the grid which is equal and opposite to that produced by P acting through the grid-plate capacity of the tube. Thus the net feed back, or tendency to regenerate is completely neutralized or balanced.

Having now determined the necessity for this neutralization, we must know how to apply this method of neutralization to the receiver.

To do that, one proceeds as follows: turn the tickler control well up against the secondary; light the filaments of the tubes and rotate both dials until the carrier wave or "squeal" of a station is located. Now adjust the dials for maximum signal strength and then lower the tickler coil to loosen the coupling between it and the secondary.

Now, by rotating the left hand dial slowly, the intensity of the squeal will be varied as the dial is moved. The intensity depends on the amount and the direction that the dial is turned.

On another page are shown two curves, which illustrate incorrect and extremes of unbalanced neutralization which are occasionally experienced in the Roberts circuit. To operate this receiver successfully without radiation, the neutralizer must be correctly adjusted. Therefore a bit of instruction on this important feature will not be amiss.

The best home-made type of neutralizer is made from a length of bus bar with spaghetti or glass insulation and a piece of copper gasoline tubing for the sliding member. Fig. 1 gives the dimensions for such a unit.

In determining whether or not your receiver is properly neutralized, one must visualize the rise and fall in squeal intensity.

The curves in the two graphs shown in Figs. 2 and 3 are somewhat exaggerated to make it easier to understand the action of the neutralizer.

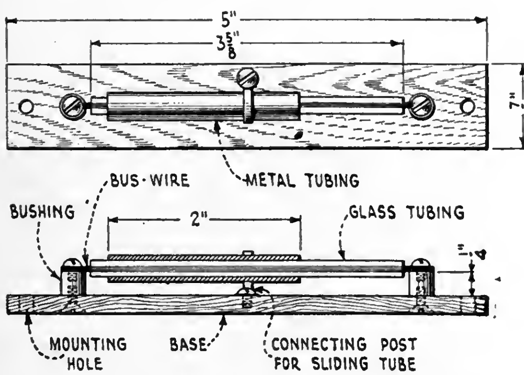


FIG. 1

How to make your own neutralizing condenser. Bakelite or formica may be substituted for the hardwood base. If it is desired, the right side mounting may be eliminated, making it possible to slide the tubing over the end. This will allow a greater range of neutralization

HOW TO TEST YOUR SET FOR IMPROPER NEUTRALIZATION

BY ROTATING the dial (Fig. 2) in the direction of the arrow, we find a quiet spot X at the reading 50 and extending one or two degrees either side of it. By continuing slowly to rotate the dial, we immediately reach the full squeal intensity indicated at B. As the dial continues to rotate, the squeal intensity gradually decreases to A. On the other

side of X, rotating the dial in the opposite direction, we immediately reach the full squeal intensity as before at C, but here the decrease in intensity is very rapid ending at D.

In Fig. 3 the action is just the opposite. The quiet point X is found at 50. Rotating the dial in the direction of the arrow, the full squeal intensity is immediately reached at B and then rapidly decreases to A. On the other side of 50 we immediately reach the full squeal intensity at C which gradually diminishes to D.

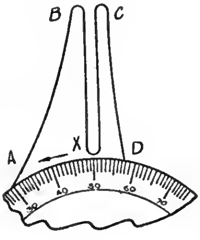


FIG. 2

An example of extremely unbalanced neutralization. Visualize your own "squeal curve" on condenser C1 in the Roberts circuit

These two examples of improperly balanced neutralization will suggest to the constructor the proper setting of the condenser. The graph showing the proper balanced squeal curve appeared in the article on the four-tube receiver.

Obviously, if your receiver produces squeals similar to those indicated in Figs. 2 or 3, the condenser tubing must be shifted until each section on either side of the quiet spot (indicated in the graph,) is equal and balanced.

It is well to remember that the same setting will not always be correct for all tubes. The Roberts receiver will operate equally well on all types of standard tubes. In the first description of the Roberts circuit appearing in the April number, two types of tubes were used, a UV-201-A and a UV-199. The only reason for this arrangement was the saving of .19 ampere in filament consumption. Naturally the neutralizer setting for these tubes would not work out efficiently if WD-12's were substituted.

In determining the location of the squeal, this characteristic noise should not be mistaken for forced or over-regeneration due to the use of high B battery voltage applied to the plate of the detector tube. However, in this operation, the tickler coil should be turned well up against the secondary. Once the squeal of a station has been located, the volume may be reduced at will by decreasing the coupling between the tickler and secondary coils.

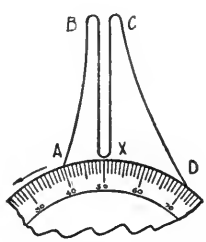


FIG. 3

Showing the other extreme of unbalanced neutralization. The correct "squeal curve" will result from a neutralizer condenser setting equal to the average of the settings in Figs. 2 and 3

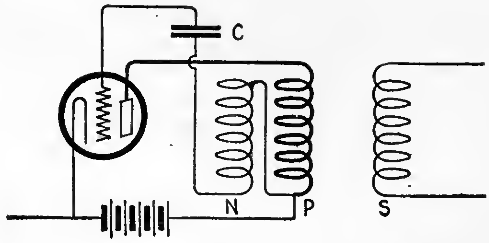


FIG. 4

The heart of the Roberts circuit. Any standard tuned radio-frequency amplifier may be neutralized by using the inductance N and the capacity C. In the Roberts circuit, S is made of 44 turns of No. 22 dcc wire wound on a spiderweb form having 13 teeth. The first turn diameter is $2\frac{1}{8}$ inches. The outside diameter is 5 inches. S is shunted by a .0005 mfd. variable condenser, preferably a vernier. Coil N-P is wound on a similar form. A pair of wires, of different colors for ease in winding and connection, are wound for 20 turns. For this coil, use No. 26 dcc wire. The outside turn of one of the wires is connected to the plate and its other end (inside) is connected to the outside lead of the other wire. From this point, a lead is brought to the B battery or phones. The inside end of the other coil attaches to the neutralizing condenser C which is connected to the grid of the tube

To adjust the regen erative action so that there is no sudden 'plop' of the regenerative squeal, regulate the detector B voltage to its most effective value for the particular detector tube used.

ANOTHER GOOD TEST

ONE of our readers, Mr. W. A. Golden, Jr., of Santa Ana, Calif., writes us as follows:

A very easy and effective method of determining the point of neutralization can be had by the use of a good crystal detector and a pair of phones connected across the antenna and ground binding posts. First tune-in a strong station in the regular manner, allowing the detector tube to oscillate and form an audible beat note with the carrier wave of the station; then listen to the phones connected in series with the crystal detector between the antenna and ground and, if the set is not neutralized, this beat note will be heard. Now adjust the small neutralizing condenser until this beat note becomes inaudible. It is a good idea when doing this to listen to the phones in the plate circuit of the tube set once in a while so as to be sure that the detector continues to oscillate and form the audible beat note at all times while the neutralizing condenser is being adjusted. When the note can no longer be heard in the phones between the antenna and ground, the set is adjusted properly and should be left permanently in this condition.

I have found this a very simple and efficient means of performing this otherwise rather difficult task.

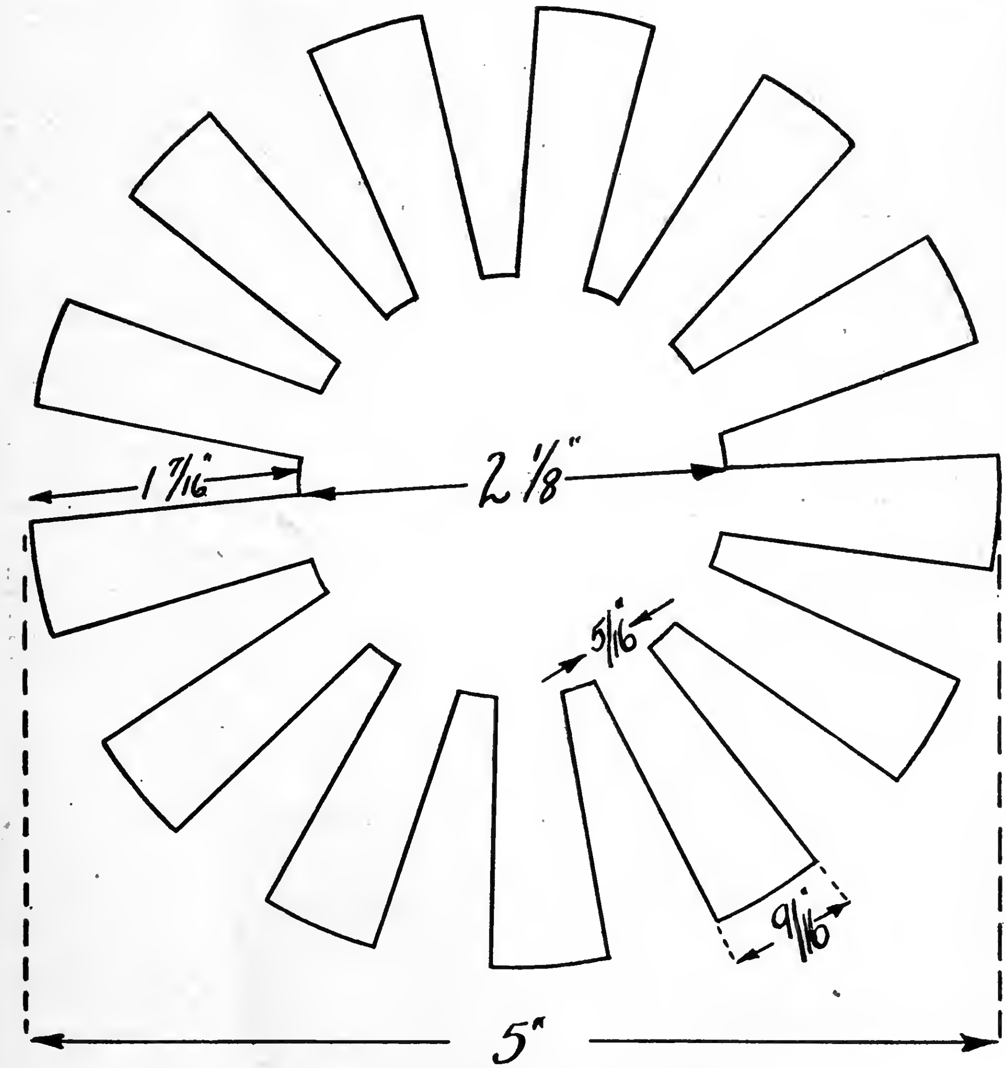
The coil winding data contained in the May Radio Broadcast is herewith reprinted with slight elaborations.

A WINDING FORM FOR THE ROBERTS COILS

IT IS recommended that double cotton covered wire be used instead of silk covered wire as the latter is more apt to wear away more quickly. Enamel covered wire may be used, providing the builder is sure there are no points at which the insulation has worn away.

Coils A-S and T are all wound the same way, that is, over two spokes and then under two spokes of the spiderweb form. The coil N-P is wound over one, then under one spoke.

The number of coil turns for the several inductances is listed below the spiderweb template. For those who wish to experiment



A TEMPLATE FOR THE SPIDER WEB COILS

Exact size. The winding for these coils, as used in various parts of the Roberts circuit and indicated by the letters are as follows: A: 40 turns No. 22 dcc wire tapped 1–2–5–10–20–30–40; S1: 44 turns No. 22 dcc wire; N: 20 turns No. 26 dcc wire; P: 20 turns No. 26 dcc wire (two wires of N and P are wound parallel as a pair); S2: 44 turns No. 22 dcc wire; T: 18 turns No. 22 dcc wire. Coils A, S1, S2 and T are each individually wound under two and over two spokes of the form. The NP coil is wound under one and over one spoke

A NEW TYPE of the P-S coil of the diamond weave winding

THE N-P-S UNIT

Made of coils wound in diamond weave. They are a new possibility for the Roberts circuit

with cylindrical coils, it is suggested that they use the same number of turns as specified for the spiderwebs and then increase or decrease the number of turns, as the case may be, until a satisfactory arrangement is provided.

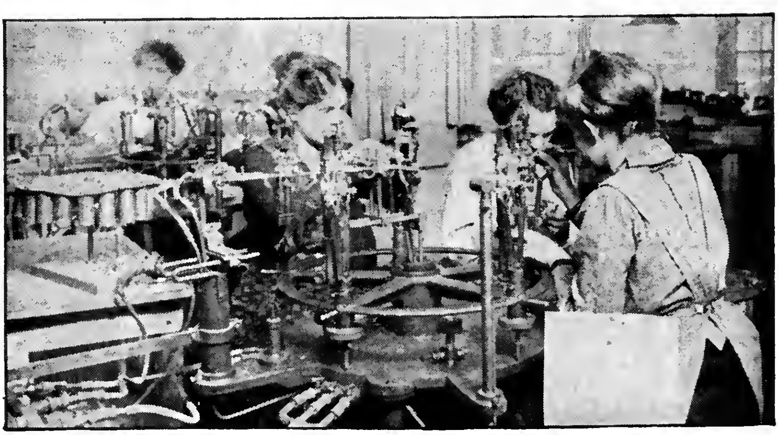
NEW COILS FOR THE TWO AND FOUR TUBE KNOCKOUT

SOME of our readers have reported some difficulties in making the two- and four-tube knockout receivers employing the Roberts circuit perform satisfactorily. We have found that in many instances this difficulty has been caused by faulty manufacture in connection with the spiderweb coils. In some of these units, the coils were wound in the wrong direction, and occasionally turns in one or more of the coils have been short-circuited.

During the past few weeks, we have experimented rather extensively with the coils illustrated here, which are made by the F. W. Sickles Company, of Springfield, Massachusetts, and have found that the difficulties referred to in the case of the spiderwebs were not encountered. With good condensers we have discovered that these coils will cover a wider band of wavelengths than was possible with the spiderwebs, permitting reception on amateur waves at the lower end and commercial stations at the upper.

The following numbers of RADIO BROADCAST have contained constructional and operating information about the Roberts circuits.

RADIO BROADCAST for	April, 1924,	pages	456 to 460
" " "	May,	"	73 to 78
" " "	July,	"	272
" " "	August	"	279 to 285 and 308 to 314
" " "	September	"	379 to 386 and 438
" " "	October	"	490 to 497
" " "	November	"	60 to 62 and 112
" " "	December	"	279 to 281



A CORNER IN A GERMAN TUBE FACTORY

The German Radio Patents

The History of Certain Important Patents Seized During the War, and Now Released for General Use

ONE of the outstanding events in the radio patent field took place Oct. 30, 1924, when the Navy Department decided to issue licenses to approximately sixty independent radio manufacturers under 129 German patents seized by the Alien Property Custodian during the World War.

Early in 1923, application for the patents had been filed, but no decisive action was taken by the Washington authorities. The coöperation of Congressman Fred Britten of Chicago, the National Association of Broadcasters, and the Radio Manufacturers' Association was enlisted.

The majority of the patents and applications involved were originally owned by the Telefunken Company, a German corporation. Among their patents is the controlling patent covering tuned radio frequency amplification—the well-known Wilhelm Schloemilch and Otto von Bronk patent. Under a series of contracts, the first dated Feb. 21, 1913, substantial rights in these patents and applications were assigned by the Telefunken Company to the Atlantic Communication Company, a German corporation organized under the laws of the State of New York.

Under the provision of the Trading With the Enemy Act, as amended, the Alien Property Custodian seized all right, title, and interest in and to these letters patent and application, which remained in the Telefunken Company, and simultaneously took over the Atlantic Communication Company.

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CONGRESSMAN FRED BRITTEN

Of Illinois, in an unconventional attitude. Mr. Britten was influential in having the radio patent situation clarified according to the recent ruling of the Attorney General

Under the provisions of the Trading With the Enemy Act, as amended, the Alien Property Custodian on Feb. 5, 1919, sold to the Secretary of the Navy, representing the United States, all right, title, and interest in and to the said patents, which had been vested in the Atlantic Communication Company and acquired by him from it. Next day the Custodian also sold to the Secretary of the Navy all right, title, and interest in and to the patents and applications which had remained in the Telefunken Company after the assignment to the Atlantic Communication Company, and which had been acquired by the Custodian.

These sales were outright, without any limitations, and covered all the rights acquired by the Government. The sale expressly includes "the sole and exclusive right, license, and authority to manufacture or cause to be manufactured within the United States, its Territories and dependencies, and within the Republic of Cuba, and the right to sell and install, to use and to grant the right to use. . . ."

THE SALE IS LEGAL

THERE is no question about the legality of sales of this nature. Title to property so acquired vests in the United States. The Attorney General has so decided.

It is also established that the grant of a revocable, non-exclusive

license to use patents valuable to the manufacture of radio apparatus is well within the discretion of the Secretary of the Navy.

On Aug. 5, 1920, the Secretary of the Navy granted to the International Radio Telegraph Company a non-exclusive, irrevocable license, without royalty, to make, use, and sell for the purposes and to the extent which the department has a right to do the inventions covered by the patents.

The theory on which the independent manufacturers requested grant of license was that such grant would tend to advance the welfare of the people of the United States and would promote a healthy competition in the manufacture and sale of radio apparatus; that to withhold such license would tend to injure the public welfare by tending to promote monopoly contrary to the policy declared by the Sherman act; that the denial of the license to the applicants would make the International Radio Telegraph Company the only licensee, which would be inconsistent with governmental policy as to monopoly.

As a part consideration for granting the license, the independent radio manufacturers agreed to grant to the United States of America, represented by the Secretary of the Navy, a non-transferable, non-exclusive license under United States letters patent which they now own or may hereafter own during the term of the agreement, to make or have made for it and use for governmental purposes apparatus utilizing or embodying the inventions of their patents, but not for sale.

It is claimed that this grant of license by the Navy Department to the independent radio manufacturers will completely change the complexion of patent litigation.

One of the chief obstacles to the greatest development of the industry is thus removed. The complexities of the radio patent situation have been minimized.

A "muffler" or "blocking" tube is a vacuum tube used in a special circuit to elimate radiation from a receiving set. The patent which covers this method of preventing radiation is owned by the United States Navy Department. Proposals have been made to release the invention to the public so that American manufacturers can develop a device to stop the interference caused by radiation of receivers.

The patent was originally issued on Feb. 17, 1914, by the United States Patent Office to two Germans, Wilhelm Schloemilch and Otto von Bronk. The patent is 1,087,892 and is titled "Means for Receiving Electrical Oscillations."

Since this patent was finally granted during the World War to citizens of Germany it was seized by the Alien Property Custodian Jan. 28, 1919. It was sold by the Alien Property Custodian on Feb. 6, 1919, to the United States Government as represented by the Secretary of the Navy. The legal title now belongs to the United States Navy Department.—*New York Times*.

THE COVERED WAGON IN NEW MEXICO

Captain Irwin navigating a pass through the mountains in New Mexico on his way to California. He is now in California where great interest is being show in the WAGON and its cargo of receivers developed in the RADIO BROADCAST LABORATORY

Principles of Feed Back Circuits

Various Applications of this Method, Regeneration, to Receivers—A Simplified Explanation

WHAT MAKES THE WHEELS GO 'ROUND: IX

By WALTER VAN B. ROBERTS

IT IS particularly fitting that this installment of Mr. Roberts's interesting series of technical discussions which we have been printing since the March, 1924, Radio Broadcast should have to do with regeneration and the feed back principle, for the interesting application of that method is one of the features of his now famous Roberts Knock-Out circuit. Many wild claims are being made these days for various neutralizing circuits, and good radio terms are being played with fast and loose. Some of Mr. Roberts's remarks may serve to clear up misunderstandings which exaggerated claims have caused. This installment is quite worth the reading.—The Editor.

BESIEGED on all sides by new circuits bearing peculiar Greekish names such as Homodyne, Neutrodyne, Pliodyne, and Superdyne, and others less mysterious-sounding but equally impressive, such as regenerative and super-regenerative, the radio enthusiast will do well to deepen his understanding of the principle of "feed back," upon which the operation of most receiving circuits depends in greater or less degree.

Fundamentally, the idea of "feed back" is quite simple: energy in the form of alternating current is picked up by the antenna and amplified by one or more vacuum tubes. Some of the amplified alternating current energy is then used to produce a voltage that is fed back to the antenna or other part of the circuit. In the simple regenerative circuit, the voltage thus fed back into the antenna increases the current in the antenna, and hence increases the strength of the signals. Figs. 58 and 59 are familiar single-circuit regenerative receivers working in this fashion. In Fig. 1, voltage is fed back into the antenna circuit by the coupling to the coil L of the coil T (the tickler) which carries the amplified alternating current.

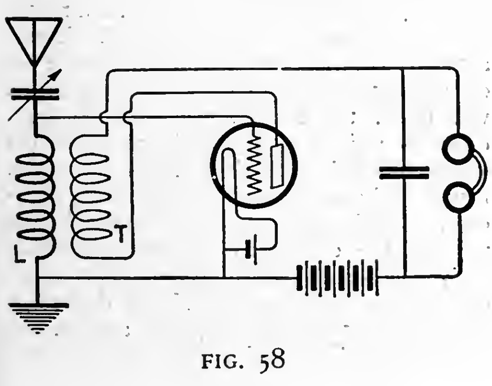


FIG. 58

74. THE TUNED PLATE CIRCUIT

IN FIG. 59, the voltage produced by the amplified current flowing through the variometer V is fed back to the antenna circuit through the capacity (shown in Fig. 59, as a small condenser drawn in dotted lines) that exists inside the tube between the grid and plate and the wires leading to them.

This latter is often called a "tuned plate circuit" regenerative receiver, but it is easy to see that the plate circuit is *not* tuned, at least not in the ordinary sense of the word, because the amount of inductance in the variometer required for regeneration is very largely determined by the filament current and B battery voltage, whereas the inductance required for tuning in the ordinary sense is determined only by the frequency of the signal.

75. RELATION OF VOLTAGE PHASE TO FEED BACK

SO FAR, only simple special cases of feed back have been considered. In general feed back has two features:

1. The amount of voltage fed back, and
2. The *phase* of the voltage fed back.

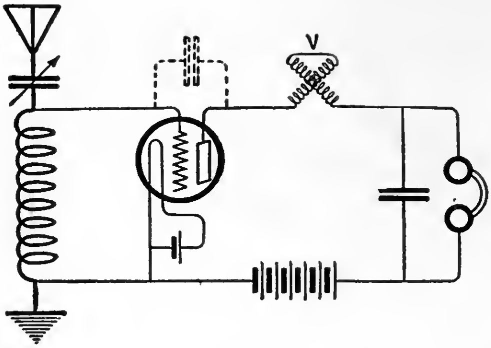


FIG. 59

While a complete explanation of the word "phase" would be too much to include here, yet those unfamiliar with it may be able to get an idea of its meaning from the following: Consider the familiar circuit of Fig. 58. Regeneration is accomplished by bringing the feed back coil T up close to the antenna coil L. Now suppose that coil T is turned around so as to present its other side to L without changing the distance between them. (Or, what is

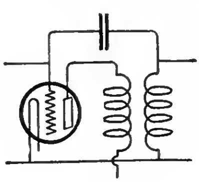


FIG. 60

the same thing, the connections to T are reversed). The *amount* of voltage fed back into the antenna circuit will be unaltered but its *phase* will be reversed, or expressed otherwise, its phase will be changed by 180 degrees. It might seem reasonable to suppose that if we turned the tickler coil only, say, a tenth of the way around we would alter the phase of the feed back by 18°. This is however not the case. In this simple circuit we can adjust the amount of feed back to whatever we want, but the only control we have over its

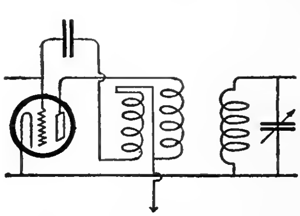


FIG. 61

phase is the choice of the two values 180° apart. If, by reversing the connections to T, we get the wrong one, the result is that instead of *re*generation we will have what might be called *de*generation, or weakening of the signals. In between these two extremes there are other possibilities. If we could manage somehow to feed back a voltage having a phase 90° different from those considered above, there would be no effect upon the signals. Feed backs having other phases cause more or less regeneration or degeneration.

76. HOW CORRECT PHASE IS ATTAINED

WHENEVER feed back is desired, whether for regeneration or to neutralize some undesired feed back, it should be supplied not only in the correct amount, but also in the correct phase. In practice, a small error in phase is not serious, as the feed back can be considered to be composed of two feed backs, one having just the right phase and the other being off by 90° and hence having no effect at all. Theoretically however it would be desirable to have complete control over both the phase and amount of feed back to any part of the receiver or amplifier, and this can be obtained in a number of ways, the same general idea being behind them all.

Perhaps the most elegant method is that shown in Fig. 62. To make things definite, suppose this represents the last tube of a radio-frequency amplifier. Coils a and b are in a fixed mounting, concentric but at right angles. The condenser in series with "a" is adjusted so that the phase of the current through "a" is the same as if resistance alone were present in the lower branch. The condenser in series with "b" is adjusted so that the *reactance* of the upper branch is equal to the *resistance* of the lower branch. Thus the currents in the two coils will be equal in magnitude but 90° out of phase. As a result, a rotating magnetic field is produced. If now a small coil "c" is properly pivoted inside the other two coils, it will pick up a voltage which will be of the same amount in whatever direction it is turned, but the phase of the voltage depends upon the position into which it is turned and can be set to any value whatever. The feed back from "c" to the desired part of the circuit can be effected either magnetically as shown in Fig. 63 or electrostatically as shown in Fig. 64. If it is desired to feed back to two different points another coil "d" may be placed inside of "c" and operated

independently of "c." In Fig. 63 the amount of the feed back is controlled by the closeness of magnetic coupling to the desired part of the circuit, in Fig. 64 by the amount of capacity coupling; in both cases the phase is adjusted

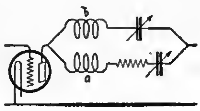


FIG. 62

by rotating coil "c." When it is desired to listen to a different station the two condensers in Fig. 62 must be readjusted, but as their adjustment is not critical they may be shafted together and the dial set to the wave length desired, the dial readings being previously

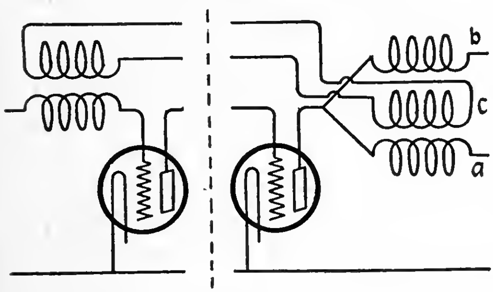


FIG. 63

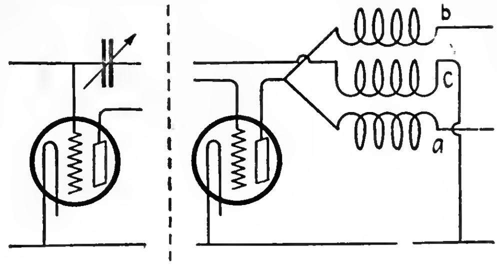


FIG. 64

calibrated in wave lengths. In actual practice a radio-frequency choke coil would have to be shunted around one of the condensers to afford a path for the direct component of plate current.

The above very general type of feed back was devised about two years ago by the writer and successfully used to control the tendency to regenerate in a two-stage Radio Corporation U.V. 1714 transformer-coupled amplifier. On account of its complexity however it is by no means recommended for ordinary use. The chief thing is that it is a general method of which regeneration, the neutrodyne, and the superdyne as well as other less well known circuits are merely simplified special cases, and if its action is well understood, many queer looking new circuits can be "solved" at a glance.

The next article in this series by Mr. Roberts will discuss the superheterodyne.

The Complete Re

Radio Broadcast Will Publish Its Own Com
Radio Broadcast Tests Involving Two

By ARTHUR

THIS number of Radio Broadcast is going to press just as the International Radio Broadcast tests are at their zenith and it is impossible to get a complete story of the most interesting radio event in history into type in time to make our presses. The first two days of the tests, every telephone in the Doubleday, Page & Company plant was swamped with local and long-distance calls, and the telegraph offices in our vicinity were overwhelmed with messages from every part of the United States, reporting successful reception of foreign broadcasts.

The forecast, made in earlier numbers of this magazine, that reception from abroad would be very generally and surprisingly successful this year, in certain contrast to last year, is certainly borne out in no uncertain fashion. Thousands and thousands of listeners have reported their success to us, and that, in spite of great atmospheric difficulties the first few nights.

We are compiling the complete story of the tests for the February Radio Broadcast, which is as soon as we can possibly print it, and we know that every radio fan, whether or not he is a regular reader or subscriber to the magazine will be intensely interested in reading the fascinating story of events radio as they progressed at our laboratory at Garden City, at the Army Air station at Mitchel Field, in the offices of the British Broadcasting Company at London, and at the *Wireless World and Radio Review* in the same city.

OFFICIAL LISTENING POSTS

WELL known radio amateurs, newspapers, broadcasting stations, and manufacturers' engineers were all appointed as official listening posts and it is going to take some time to group their reports and to analyze their experiences. Some of the best radio locations in the New York territory were secured and special receivers installed. Stories of loud-speaker reception of the foreign stations await only the telling.

An official of the New York office of the United Press told us that the interest expressed by newspapers all over the country as shown by telegrams and telephone calls in their office was "positively phenomenal." Several men in the various news services did nothing

port in February

plete and Exclusive Story of Its International
Continents and Millions of Radio Listeners

H. LYNCH

else for several days but devote themselves to handling news matter about the tests.

The International Radio Broadcast tests are full of powerful potentialities for international betterment and a firmer basis for understanding. More than one person has agreed with us on this stand. We have the following copy of a telegram which bears out this contention and phrases the idea in most powerful fashion.

RADIO WTAS
KIMBALL BUILDING
CHICAGO

HEARD MENTION LAST EVENING OF TONIGHT'S GALA PROGRAM AND CONGRATULATE YOU THEREON STOP THIS WEEK IS CERTAINLY A GALA EVENT IN RADIO BUT PEOPLE SEEMINGLY REGARD INTERNATIONAL BROADCASTS AS JUST INTERESTING FEATS STOP MOMENT'S THOUGHT WILL REVEAL AMAZING POTENTIALITIES FOR BENEFIT MANKIND IN FREE EXCHANGE OPINIONS BETWEEN NATIONS STOP IF ANYTHING WILL PUT ALL BATTLESHIPS AT BOTTOM OF OCEAN WHERE THEY BELONG UNDER A REAL CIVILIZATION RADIO'S INFLUENCE IN PROMOTING BETTER UNDERSTANDING AND MORE INTELLIGENT PUBLIC OPINION AMONG THE NATIONS WILL BE THAT FACTOR

ERIC H PALMER BROOKLYN NEW YORK
24 NOVEMBER 1924

We shall make an effort to print the names of all those whose reception of the foreign programs has been verified, but the number may grow too large by the end of the test, in which case other arrangements will have to be made.

All the American broadcasters showed unanimously that they appreciated the importance and interest attaching to this test and were good enough almost unanimously to keep off the air during the foreign transmission periods. It was almost without exception that the American stations kept off the air and used every means within their power to see that the American air was free for listeners on this side. This involved considerable sacrifice on the part of some of the stations who had contracts with various organizations.

The official detailed story complete with exclusive photographs will appear in February.

WHEN YOU WRITE THE GRID . . .

Don't fail to enclose a stamped, self-addressed envelope with your inquiry if you expect a personal reply.

Don't be impatient if you do not receive an immediate answer. Every letter is answered in the order of its receipt. Do not send a second letter asking about the first.

Look over your files of RADIO BROADCAST *before asking a question which might have been covered in a previous issue.*

Don't ask for a comparison between manufactured apparatus. The addresses of manufacturers of articles used in the construction of apparatus described in RADIO BROADCAST *will be given on request.*

Don't include questions on subscription orders or inquiries to other departments of Doubleday, Page & Co. Address a separate inquiry to The Grid.

Don't send us a fee for answering your questions. The Grid Department is maintained for the aid and convenience of readers of RADIO BROADCAST *and there is no charge for the service.*

QUERIES ANSWERED

How may I add an R. F. amplifier to my Haynes super'?

W. H.—Baldwin, L. I.

How can I insert a jack in my circuit for loop use?

E. J. B.—Lansing, Mich.

What is a counterpoise and how is it used?

L. W. A.—Chicago, Illinois.

Can you give me a few points on trouble-shooting in the Knockout Crystal reflex circuit?

W. E. D.—Peru, Indiana.

My Roberts receiver does not operate correctly. How can I test it for defects, etc.?

C. J. F.—Chicago, Illinois.

Can cylindrical coils be used in the Roberts circuit?

M. J. M.—Atlanta, Georgia.

Will you publish a buzzer circuit for the practise of code?

A. W. M.—Bronx, New York City.

What rheostats should be used with 201-A tubes?

R. N. R., Memphis, Tennessee.

MAKING THE "SUPER" MORE SENSITIVE

FOR those who, like Mr. W. H., wish to make their Haynes super-heterodyne more sensitive to weak signals emanating from great distances, the information contained herewith should be helpful.

The circuit in Fig. 1-A shows the use of an antenna and an extra stage of neutralized radio-frequency amplification placed before the first detector tube of the "super" receiver. It is quite necessary that this stage of amplification be neutralized, especially when the antenna is used, so that radiation does not occur. Ordinarily a good super does not require the use of an antenna as a collective agency and its use is poor practise. In Fig. 1

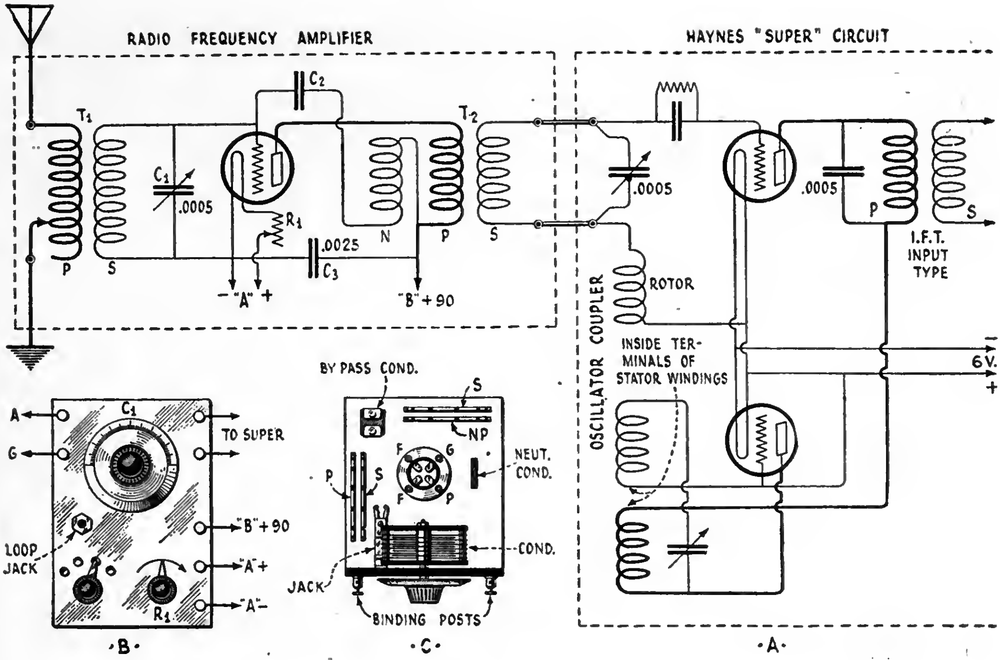


FIG. 1

its use is indicated for general purposes when the R. F. amplifier is connected with other circuits. The method for plugging in a loop is shown in Fig. 2.

Explaining the circuit in Fig. 1-A, no changes or alterations are necessary in the Haynes circuit. The amplifier may be constructed so as to be entirely contained in its own cabinet as a separate unit. See Fig. 1-B and C. For the sake of compactness P and S of T1 and N P-S of T2 may be wound on spiderweb forms similar to those used in the Knockout Roberts receivers. The number of turns for each coil is as follows:

T1-P 40 turns No. 22 dcc wire—S 44 turns No. 22 dcc wire. T2-N 20 turns No. 24 dcc wire—P 20 turns No. 24 dcc wire—S 44 turns No. 22 dcc wire.

If it is desired, P of T1 may be wound with about ten turns to make the antenna circuit a periodic or untuned. C2, the neutralizing capacity may be made by connecting a 4″ piece of bus bar to the grid post of the tube. A piece of spaghetti insulating tubing is slipped over it and on top of this is wound two or three inches of bare wire with the turns soldered together making it one continuous piece of wire tubing. C1 is a .0005 mfd. variable condenser preferably of a vernier type.

Coils N and P are wound as a parallel pair of wires. In this instance two spools of No. 24 dcc wire may be used for simultaneously winding both turns together. A panel and base layout are shown for use primarily as a guide, not as an actual definite placement for the parts. This type of amplifier will fit in nicely as an addition to any type of receiver. See articles in the March and May, 1924, Radio Broadcast for additional details.

DOUBLE CIRCUIT JACK FOR CHANGE-OVER PURPOSES

IN THE multi-tube radio frequency receivers, super-heterodynes, and neutrodynes, a double circuit jack may be included to change automatically from loop to antenna by merely inserting a plug to which the loop has been connected, in the jack. This feature will also apply especially to those who are inclined to experiment with couplers of various designs, antennas, loops, etc. The circuit in Fig. 2 shows how the adaption is made. The secondary of an additional coupler may be connected to the inserted plug which is of the Weston or other "instant change" type.

USE AND VALUE OF A COUNTERPOISE

MANY operators of receivers are troubled by broad tuning or by their peculiarity of picking up local disturbances caused by telephone ringers, house-lighting circuits, vacuum cleaners, elevators etc. Usually these defects may be attributed to faulty ground systems to which many of the above named apparatus are connected. A counterpoise, very similar to an ordinary flat top antenna, excepting that it is mounted just above the earth or in the cellar of one's home, may be advantageously employed to eliminate these forms of disturbances. In Fig. 3, several forms of counterpoise are shown with their constructional details and method of use. It is only necessary to remember that to be efficient they should be well insulated from near-by objects. Any type of wire, insulated or bare, may be used. Porcelain cleats may be economically used as insulators. The counter-

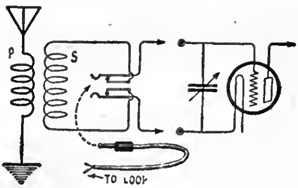


FIG. 2

poise is connected to the radio receiver in place of the ordinary ground connection.

USING STANDARD PARTS FOR THE ROBERTS CIRCUIT

IN THE matter of substitute coils to replace the spiderwebs used in the Radio Broadcast Knock-out circuit, it is well to understand from the start that endeavors along these lines so far have been experimental in nature. Many experimenters are working on the problem, and in a short while no doubt the needs of all will be satisfied in this particular connection.

Radio Broadcast has experimented with various forms and herewith is presented a few guiding facts which may prove helpful to those who wish to experiment of their own accord.

In most instances those couplers now on the market such as Ambassador, Shamrock, Fischer, Eastern picklebottle, and others of a similar constructional nature may be advantageously experimented with by merely adding to, or rewinding the primary coil constituting the N-P winding of the Roberts circuit. The turn ratio between primary and secondary will vary according to the coupler used and no definite value can be given. In general it is well to use the same number of turns as specified for the spiderwebs, then vary for satisfactory operation. Instead of a double wound primary a coil of twice the number of turns as specified may be used taking off a center tap as shown in Fig. 5 and 6. In most instances the placement of the primary N-P coil will have a very decided effect upon the operation of the receiver. The usual practice is to rewind the primary N-P coil directly over the secondary with cambric cloth insulation between the two.

Standard neutroformers offer an opportunity for interesting experiment. The present primaries may be removed and double-wound coils substituted. In this case the N-P coil would consist of as many turns per coil as the removed primary. A variometer in the plate circuit of the detector tube will provide regeneration.

Mr. Roberts, in his original article describing the two-tube receiver, mentioned the fact that the two wires constituting the N-P winding should be wound physically as close together as is possible. From Mr. Roger Whitman, Associate Editor of *Country Life*, comes the suggestion of cutting two pieces of wire long enough to provide 20 turns each for the N-P coil and twist them together. Mr. Whitman has found that with about 3 to 5 twists to the inch this arrangement provided more stable, sharper operation. Figs. 4 and 5 are illustrations of the various points explained herein. Fig. 6 shows the circuit diagram for the connection of the coupler with the split primary illustrated in Fig. 5

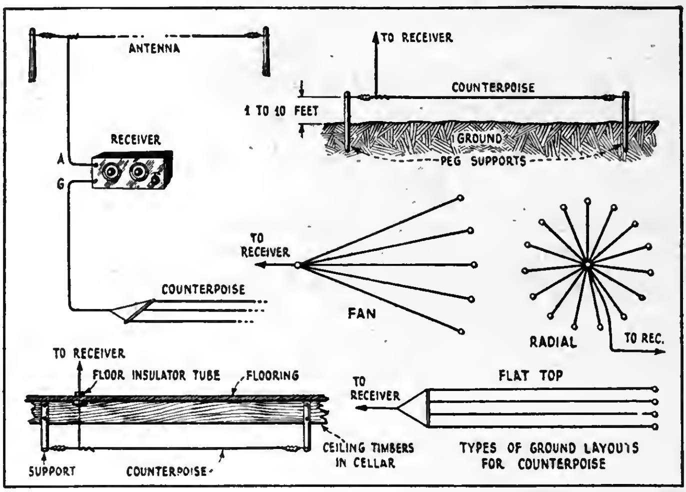
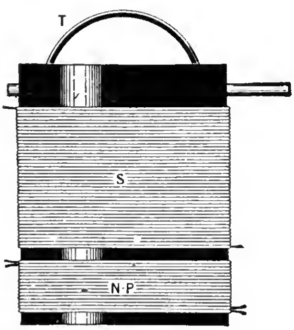


FIG. 5



DOUBLE WOUND N-P COIL
PLACED ON SAME PLANE
WITH SECONDARY

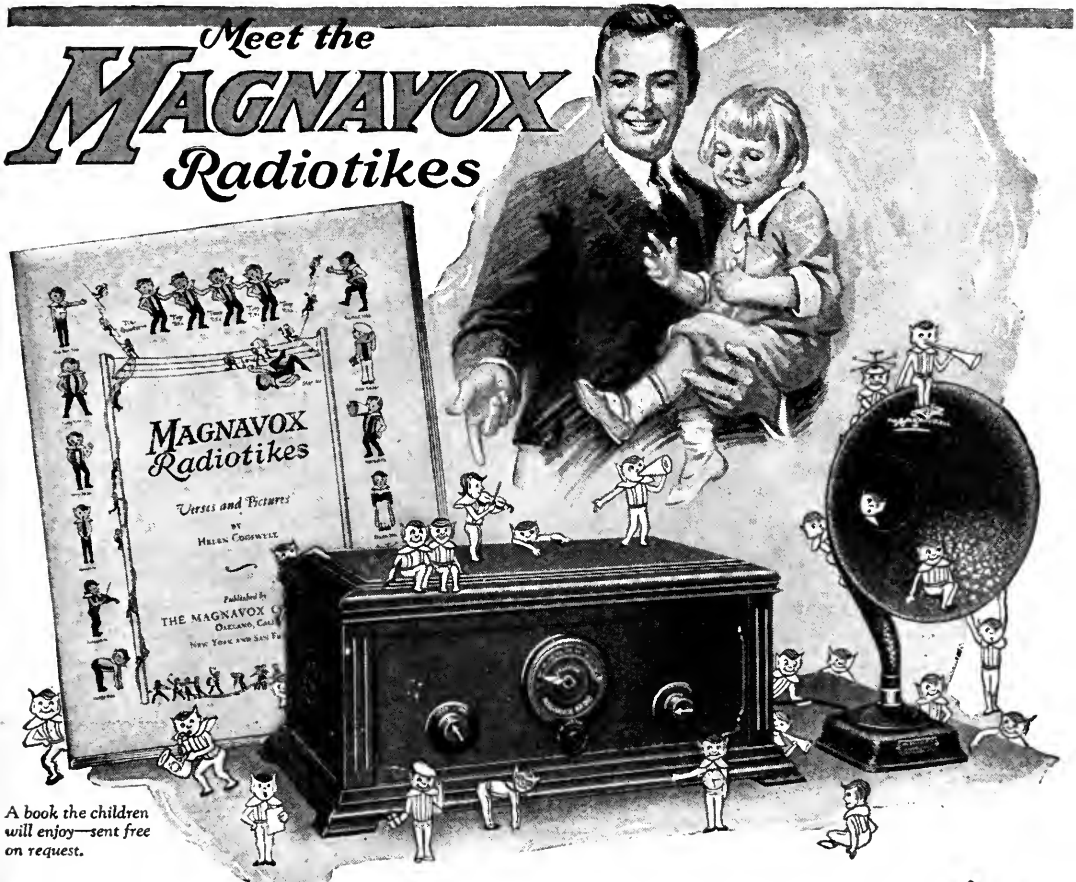
FIG. 4

GENERAL POINTERS ON THE ROBERTS CIRCUIT

MR. C. J. F'S. question is similar to a number of others received by The Grid. The following general pointers will serve as an aid in locating and eliminating the troubles sometimes found in the Radio Broadcast Knock-out Roberts receivers.

1. Check over all the parts to be used, before assembling, with a view to preventing the use of defective parts. A pair of phones and a C battery, used as a testing circuit, will uncover any open circuits in the various coils, transformers etc., and any possible short circuits in the several condensers to be used.

2. Tubes offer one of the greatest hindrances to proper, efficient operation. This is



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especially true in the case of the detector tube. Change around the tubes until their best operating position is found.

3. Manufactured and home-made coils may be so mounted that the direction of winding in several of the coils is found to be opposite. Check over the coil assembly and be sure that

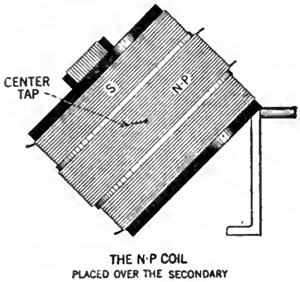

FIG. 5

all the coils are mounted so that the winding direction in all the coils is the same.

4. When regeneration does not occur, it is an indication that the tickler coil is reversed. Also, the B battery voltage on the detector tube may be too low. On the other hand, if regeneration is too pronounced, the circuit going in and out of oscillation with a decided "plop," it is quite evident that excessive detector plate voltage is being applied and must be reduced for more stable operation.

5. Howling may be due to (a) an interaction or feedback between the several circuits; (b) Reversed leads to the primary of the audio reflex transformer. (c) Incorrect values of C battery. In some cases it will be found necessary to ground the negative side of the A battery to obtain stability.

6. Grid leaks clear up, to a marked degree, the volume and tone quality delivered by the receiver. Try various values of leak and grid condenser.

7. The spiderweb coils, as designed, will cover the entire broadcasting wavelength when the secondaries are shunted by .0005 mfd. variable condensers. When the sensitivity of the receiver varies for different wavelengths, that is to say, when signals received are louder on the lower wavelengths than on the higher wavelengths, the receiver is then in a condition where the step-up of energy is not the same over the entire wavelength scale. To overcome this, the primaries and secondaries of the two couplers must be made semi-variable so that resonance may be obtained at all the wavelengths. Variation of the turn-ratio between primary and secondary will also serve to eliminate this trouble.

8. The use of a by-pass condenser shunted across the C battery and secondary of the audio reflex transformer as outlined in the November GRID is not a general cure-all for poor volume output. In a majority of cases this procedure does "tone up" the receiver quite appreciably. This usually depends upon the value of C battery and type of audio reflex transformer used.

TROUBLE SHOOTING IN THE CRYSTAL REFLEX RECEIVER

THE use of good, tested crystals in the RADIO BROADCAST Knockout crystal reflex receiver cannot be emphasized too much. Poor crystals will cause squealing due to regeneration

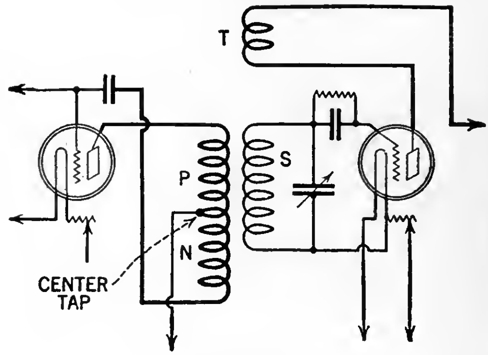

FIG. 6

produced by a high resistance contact on the crystal This condition also causes body capacity effects resulting in unbalanced operation.

It is essential that the negative side of the A battery be grounded. It would be well to have the negative side of the A and B battery connected together, thus providing a common ground for both

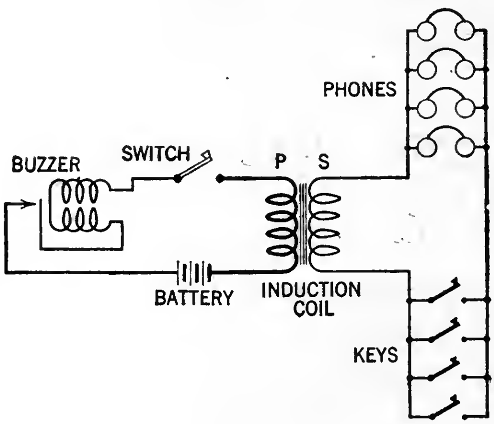

FIG. 7

batteries. In some cases, due to internal characteristics of the receiver this does not work out well and it is necessary to connect the negative B to the positive A post.

A CIRCUIT FOR CODE PRACTICE

THOSE who have a longing to know the code used in radio communication will find the circuit shown in Figs. 7 and 8 useful in the practise of sending and receiving dots and dashes. The system is especially applicable to Radio Clubs,

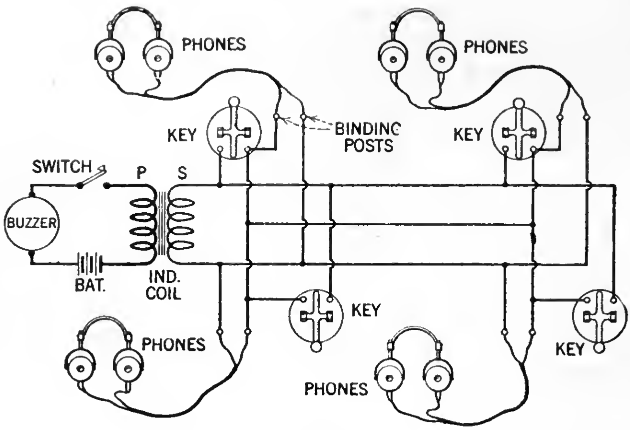

FIG. 8

A picture diagram of the actual layout of the parts and wiring. Only the keys, buzzer, coil, binding posts, etc., need be mounted on the top of the operating table while all the wiring is made on the under side. As may be seen from the schematic diagram in Fig. 7 the secondary-key-phone circuit is a series parallel one allowing provision for additional operating positions

school classes, and other organizations desiring a means for group practise.

The material needed is a buzzer capable of producing a high-frequency note (the General Radio and Federal buzzers are very good for this work) a telephone induction coil, a switch, a key and pair of phones per person, and the necessary batteries.

By arranging the parts as shown in Fig. 8 the circuit may be controlled by any one of the keys, the signal being heard in all the phones. In this way it is possible to maintain intercommunication between the several receiving points.

By putting the buzzer in a continuously operated circuit, the tone produced will be more constant than if the several keys were used to interrupt the buzzer circuit. Also, by placing the keys in the secondary side of the circuit there will be no appreciable "lag" or "key thump" in the signals as transmitted.

A POWER AMPLIFIER AND C BATTERY

THE fundamental idea involved in the design and construction of a power amplifier is briefly outlined in the circuit shown in Fig. 9. First, a low ratio audio frequency transformer is necessary to prevent distortion and unbalance in the input side of the vacuum tube. The resistances unit composed of various values of resistance from 25,000 to 100,000 ohms directly shunts the secondary of the audio frequency transformer and is a positive means for controlling the volume with its resultant distortion. The Bradleyleak and other commercial types of variable resistance are admirably suited for this use.

In a unit of this kind a power amplifier tube works better than the ordinary type of vacuum tube—the UV201A. The standard 5 watt tube or any of the Western Electric power amplifier tubes are fine for this purpose. Power amplifier tubes require a higher plate voltage than the UV201A's and in most circuits the addition of a C battery inserted in the lower lead of the secondary of the transformer returning to the negative side of the filament supply will often clarify and stabilize the circuit quite noticeably. The negative side of the C battery should connect to the secondary of the transformer and the positive terminal of the C battery should connect to the negative side of the filament supply. The value of C battery is governed by the amount of plate voltage used and is outlined in the following table:

PLATE VOLTAGE	C BATTERY VOLTAGE
40	0.5 to 1.0
60	1.0 to 3.0
80	3.0 to 4.5
100	4.5 to 6.0
120	6.0 to 9.0
150	9.0 to 12.0

The use of a C battery in any audio-frequency amplifier circuit will materially reduce the current drain on the B batteries, thereby increasing the number of hours of use of these batteries. A C battery will also permit a vacuum tube to function at its most efficient point of operation, amplifying the signal applied to the grid of the tube in a distortionless and also economical manner.

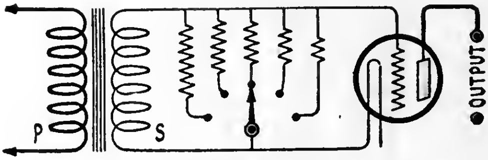

FIG. 9

Shows a power amplifier circuit. The volume output is controlled by the shunt resistances

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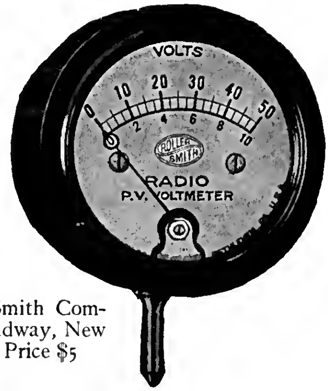
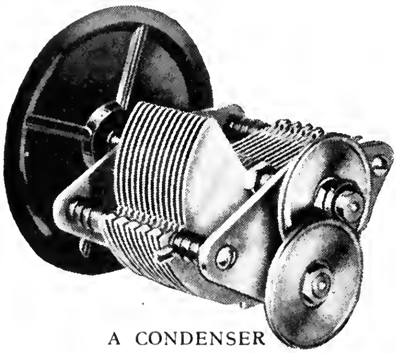
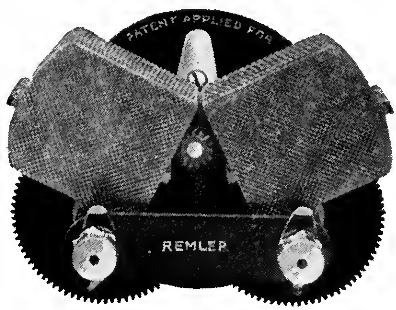




A CONDENSER

Of the all-vernier type, the vernier control is attained by means of the friction plates showing at the back of the condenser. One possibility of loss is eliminated because the stator plates are stamped from one piece of aluminum and not severed. A very good range of capacity is covered. Made by the U. S. Tool Company, Inc., 117 Mechanic St., Newark, N. J.



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An instrument of novel design very well built. The photograph is the rear view showing the embossed plates, twin rotors, and all-vernier control. Made by the Remler Radio Mfg. Co., 154 W. Lake St., Chicago, Illinois

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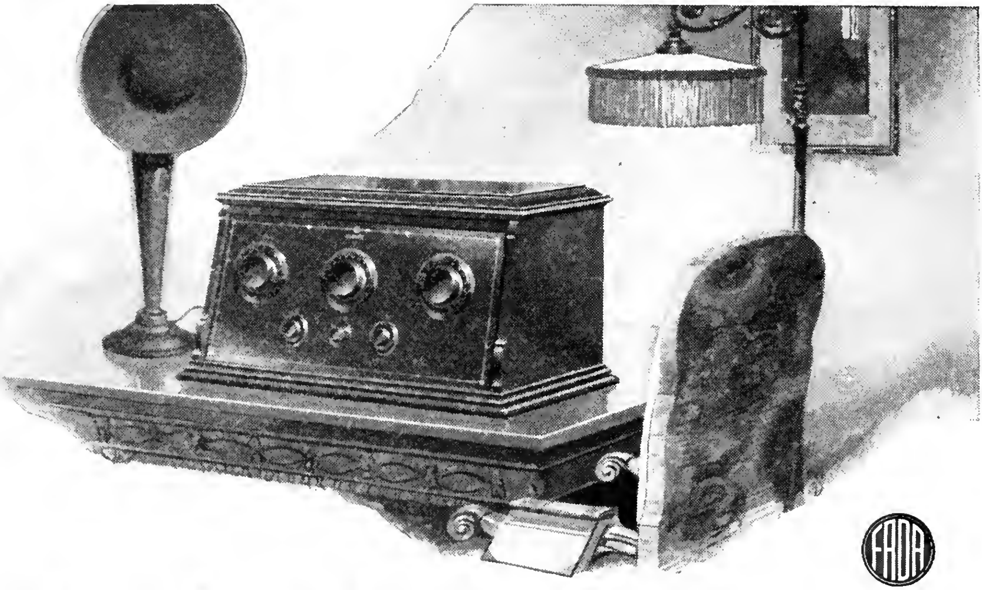
The Splitdorf receiver is a five-tube neutralized set of the tuned radio-frequency type. It is of fine appearance and a very pleasing set to operate. Made by the Splitdorf Electrical Co., 392 High St., Newark, N. J. Price $150



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Simplicity of control? Anyone, without experience, can operate the Neutroceiver. You can turn your dials to previously located stations and bring them back night after night.

Beauty? As a piece of art-furniture, the FADA Neutroceiver is a masterpiece. The cabinet is solid mahogany, with the panel perfectly balanced and sloped gently to facilitate easy tuning.

Supplementing the FADA Neutroceiver and making a complete FADA line, are five other Neutrodyne receivers—three, four and five tube sets—in plain as well as artcraft cabinets. You have a price range from \$75 to \$295 from which to select. Each model extraordinary in results; each a remarkable value. See your dealer.

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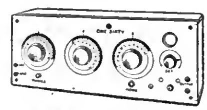

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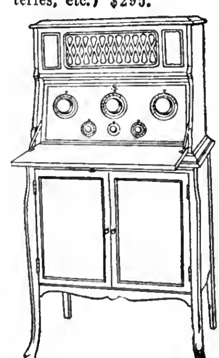

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Among Our Authors

REMINGTON SCHUYLER is represented with the cover on RADIO BROADCAST this month and a story "Static Days and Nights" both of which tell some of his experiences in ranch life in the West. "Building a house has certainly kept me busy," writes Mr. Schuyler, but my first celebration in the new home is going to be a Four-Tube Knockout set." Mr. Schuyler is one of the best known of American painters of Indians. During Maréchal Foch's recent tour of this country he was official American Legion painter and made portraits of French and American officers on the trip.

REMINGTON SCHUYLER
In Indian Costume

IN SEEKING release from amateur photography, I found a substitute in radio. I hocked all my cameras and bought condensers. I haven't had a fish rod in my hands since I became infected. I am fond of soldering paste in my coffee and own a Roberts Knock-out receiver." The photograph is a flashlight of Mr. Bradford being much pained by the squealers. Mr. Bradford, cartoonist for the Philadelphia *North American*, did the cartoon which appears as our frontispiece this month.

W. R. BRADFORD
In a self-posed photograph, saying something definite about "bloopers"

B. F. MIESSNER is a consulting engineer with Wired Radio, Inc., New York. He has been for many years engaged in radio and electrical work for the Navy, John Hays Hammond, Jr., and Emil J. Simon. For a time, he was director of the acoustical research laboratories of the Brunswick Balke Collender Company at Chicago. Mr. Miessner invented the Automatic Heliotrophic Machine (the Electric Dog). He is also the author of *Radio Dynamics*, published by D. Van Nostrand and Company.

B. F. MIESSNER

JAMES MILLEN is a student at Stevens Institute of Technology and is specializing in radio work.

ALBERT C. ALLEN "was born and raised in the regular army, and served in the Spanish and Phillipine wars." He has always lived in what he calls "the real West"—West of the Rockies, and has of late been particularly interested in horticulture, and also in photographing wild life.

ALBERT C. ALLEN
Taking movies of wild life

ROBERT H. MARRIOTT is not unfamiliar to readers of this magazine, for his contributions have appeared here quite frequently. One of Mr. Marriott's distinctions is that he was the first president of the Institute of Radio Engineers. He was one of the first to take up radio engineering as a profession and began actively in 1901. He is now chief radio engineer for the Puget Sound Navy Yard at Bremerton, Washington.

FRANK E. BUTLER is well known to many old timers in radio when it was wireless. The story of his experiences with Dr. Lee De Forest in the early experimental days is printed in this magazine for the first time, and, according to the mail we are receiving in the office, is attracting an unusual amount of attention. There are more articles by him to follow.

MC MURDO SILVER is a rare combination among radio men. His spare hours, instead of being devoted to radio, as are those of most other radio men, are devoted to James Branch Cabell, Arthur Machen, and Roland Firbank.

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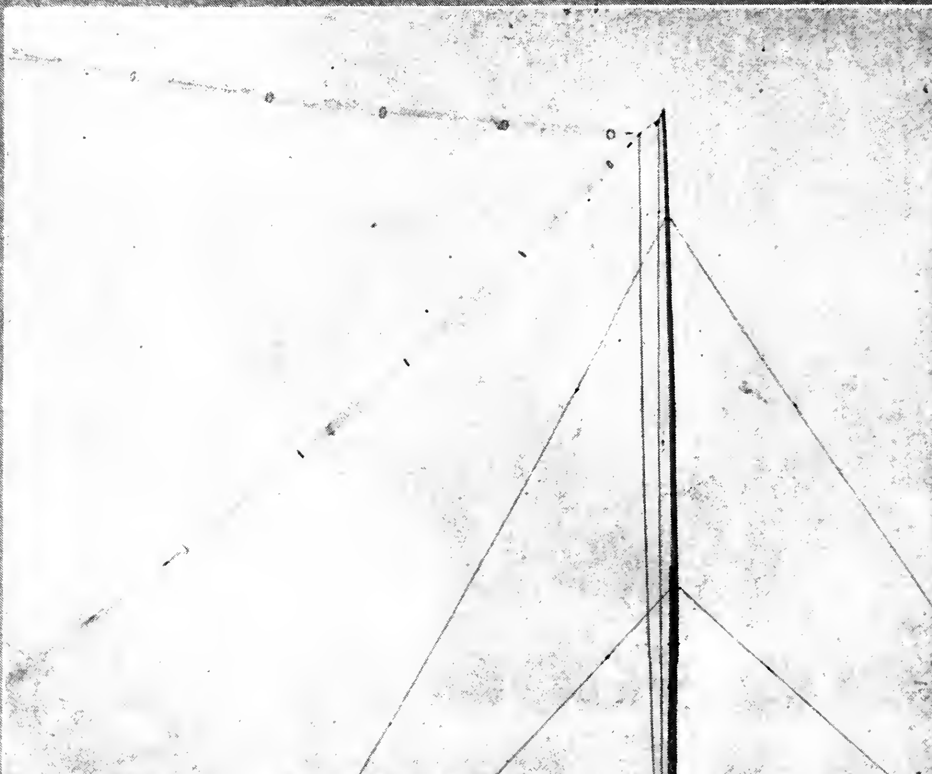


THE HUB OF THE INTERNATIONAL RADIO BROADCAST TESTS

The masts of the receiving and transmitting station at the laboratory of this magazine. Two separate cage antennas are used, one for receiving and one for transmitting. The insert shows a corner of the laboratory with John B. Brennan, Willis K. Wing, and Zeb Bouck of the editorial staff. Mr. Brennan is operating a super-heterodyne and a Knockout four-tube receiver as an alternate. Mr. Wing is operating the line which controls the wireless circuit to London, and Mr. Bouck is talking over the radio to official listening posts at Mitchel Field

RADIO BROADCAST

Vol. 6, No. 4 February, 1925

How Michael Pupin Succeeded

A Story Which Reads Almost Like a Chapter From Horatio Alger, Jr.—The History of "Immigrant to Inventor," Whose Electrical Inventions Have Greatly Aided Radio, the Cables, and Telephony

By MYRA MAY

A STURDY, dark-haired boy, clad in a summer suit of clothes and wearing a red Turkish fez, crept close to a stack on an ocean liner during a particularly cold March crossing to America in 1874. He was a queer figure, this youngster of fifteen, minus the traditional mattress and blanket of the immigrant, with no friends or family aboard and only the warm smoke stack for company.

Yet he kept his courage, although he had only five cents in his pocket, when he landed at Castle Garden, at the Battery, New York. The genial sunshine, the activity in the harbor, the swarms of people, all thawed out his loneliness and augured that he had reached the land of opportunity. When he left the ship, he bought a prune pie from a vendor. The pie, however, proved a snare and a delusion. It was filled with prune pits instead of the actual prunes. Having spent his entire capital, he nonchalantly strolled up Broadway.

So Michael Pupin, now professor of electro-mechanics at Columbia University, and widely known as the inventor of the Pupin coil, entered America.

He had run away from home. Back in Hungary, he had been known as a bright boy who had too easily absorbed the nationalistic theories of the radicals and so had been transferred from his own local school to Prague. There, disgusted with the military spirit of the academy, he decided to run away to America. It was a sudden decision. There was no time to write home and discuss the plan, but time only to hurry to Hamburg where an immigrant ship bound for America sailed. To supplement his scanty funds, he sold his warm clothing,

> "The more boys work with their apparatus, the more knowledge of the science of electricity they will obtain and the more will their interest in the marvels of radio be aroused. Radio is the coming science and if its disciples attain as much practical experience and grounding in electrical principles as is possible to crowd into their lives, they can be sure of making progress."
>
> —PROFESSOR PUPIN.

his books and even then, lacking sufficient money, he had to sell his heavy sheep's wool overcoat and cap to eke out his steerage fare. Then clad in the light summer suit—his sole remaining garment—plus the red fez, he came aboard.

Immigrants had to supply their own bedding. But young Michael Pupin, too poor to buy even a mattress and blanket for the hard bare floor of a third-class ship, hugged close to the smoke stack and fought off intruders. He had national traditions and five cents to bring to the new country.

Discharged from Castle Garden, Pupin looked with bewildered eyes at the clanging horse cars, at the thick network of telegraph wires overhanging the buildings, at the handsome new custom house, at the New York of 1874. Prague and Budapest had seemed bustling cities compared to his native village but the vastness of New York overshadowed even those cities.

Once in a Lifetime

The story of the success of Michael Pupin, who progressed from a poor immigrant, who landed in New York with five cents in his pocket, to a famous scientist known and respected by the entire world is one which can't be read very often. But a success such as his happens just frequently enough to assure the world that such things can happen, after all. It was not altogether by what the enthusiastic fiction writers call "sheer pluck and indomitable energy" that Pupin arrived at the position he now holds. There is a great deal of what we call ability involved. Professor Pupin, in addition to being a scientist of unquestioned standing and prominence, is personally, a tremendously good fellow, as any of his acquaintances will tell you. Miss May's story is published through arrangement with Charles Scribner's Sons, New York, who publish his autobiography, *From Immigrant to Inventor*. Many of the photographs used in this article are reproduced through the courtesy of Scribner's.

—The Editor.

TWO-FISTED AMERICANS

HE WAS soon accosted by a group of newsboys attracted by the novel fez. Pupin could speak no English, and the bully of the crowd, finding that he could not fight him with words, substituted fists. These Pupin understood much better. In his native Hungary, he had tended cattle and out in the open had learned wrestling from the sportive herdsmen. He was lithe and strong. It was not long before he had his adversary down on the ground yelling "enough."

"I then had my first introduction to America," Professor Pupin relates. "In Europe a crowd stuck together, putting up a united front against the stranger. Over here, on my first morning, the newsboys initiated me into the fraternity of fair play. When the boys saw that I had won the fight honorably, they cheered me and when a large official in blue suddenly appeared, they apparently interceded in my behalf, for the large official dropped his gruff tones, released my arm and even handed me my battered fez, torn and dusty from the scuffle. My adversary shook hands with me and as I swaggered back to Castle Garden the whole crowd cheered. I already liked America.

Even in far-off Hungary the fame of Franklin and Lincoln had penetrated. Now, while working on a Delaware farm—almost his first job—the immigrant boy learned the legends of Pocahontas, of the Jamestown settlement, the gallant Captain Smith, and many of the other blood-quickening tales of pioneer America.

IN PHILADELPHIA LIKE FRANKLIN

THE lessons which I learned from my farm teacher seemed to prove that America was a great country with equal opportunities for all if we could only take advantage of them," Professor Pupin says. "I made up my mind to find new opportunities for myself, to leave the Delaware farm and to journey to Philadelphia."

"I had compared myself to Benjamin Franklin, whose story I loved because he had been my incentive in coming to America and because he had first awakened an interest in electricity. I made my entrance into the town in the most approved Franklin manner, walking along the street eating a roll. Although I wandered five days I could find no work. I was ready for opportunity but it seemed to have passed me by. My heavy farm boots were almost worn out from hard use I had given them while I searched for a job. My ten dollars—wages I had brought from the farm—was nearly gone. As I sat in Fairmount Park and ate a big Philadelphia bun, I reflected that even Franklin with all his hardships, had been an American and had known the printing trade and all I knew was

how to drive mules. While I moodily speculated on my difficulties, a farmer approached me and offered me a job driving mules. I accepted and once more left for the country."

But the farm was hot, the opportunities to learn English or a new trade negligible, so once more Pupin took up his wanderings. From the farm in southern Maryland, he journeyed to Baltimore and thence to New York. In those days before the Pennsylvania tunnel, trains deposited their passengers at Jersey City and a ferry took them over from there to New York. Along with the rest of the crowd, Pupin was landed in lower New York in the heart of the shipping district.

As he walked uncertainly through the unfamiliar neighborhood, he saw a small hotel with a German name. It was an oasis in a region of strange sights and sounds. The proprietor had a son about Pupin's own age and the two became friends immediately.

Pupin's funds were so limited that the two boys decided their first consideration must be to get him a job. This, however, was no easy matter. During the previous year the entire country had suffered from the great panic of 1873. This was the summer of 1874, but the country was not yet settled again. There was widespread unemployment. No matter how early the two boys went in response to advertisements for labor, they were sure to find long lines ahead of them. In those gloomy days men were so desperate they waited all night at the newspaper offices so that they could read the "help wanted" inserts in the first editions and stand all night in line to apply for work the next morning.

Pupin and Christian, the son of the hotel keeper, soon discovered that the erstwhile farmhand would never get a job in this way. More drastic methods were necessary in a neighborhood so close to the shipping center. The opportunity finally presented itself. During a strike of longshoremen, Christian, who acted as Pupin's business manager, signed up his client as a scab.

"My job was to help the sailors paint the ship," Professor Pupin remembers. "Partly as a means of protecting us from the strikers and partly as a means of getting the work done quickly, we substitute workers were out in the bay. Of course, I knew nothing about painting but bitter need for employment will give us ability to do almost anything. At the end

CASTLE GARDEN, NEW YORK

Where Pupin landed from the German immigrant ship in 1874. Castle Garden has since been converted into the Aquarium and immigrants no longer land there, but down the Bay at Ellis Island.

of three weeks, when I returned to the little German hotel and my friend, I was a full fledged painter with thirty dollars, which was more money than I had ever earned before.

My new found work was short-lived. Christian left town for a Western city and I, with my best friend gone, was no longer interested in the German hotel. I rented a small room near Cooper Union, in an entirely different part of New York.

WHERE HIS STUDY REALLY BEGAN

THEN I started hunting work as a painter. Conditions were hopeless; more than a year had passed since the great panic, and labor was still a drug on the market. I tramped the streets from early morning until the last shop closed, but I could not find employment. My little hall bed room was so unfriendly that I formed the habit of spending my evenings at Cooper Union. Here I first read of the mysteries of science and tried to reason out the phenomena of sound and light.

"After I had hunted work in vain for several weeks I finally created a job for myself. I followed coal wagons and when the coal was dumped in front of its destination, I would offer to put the coal in the cellar for fifty cents a ton. It was back-breaking work. I frequently toiled two days to make a half a dollar. But when it was over, I could buy a bowl of filling bean soup and a chunk of brown bread for five cents at the Bowery Mission, so I never starved.

"When the coal was in the cellar I would suggest that I paint the walls and ceiling of the basement. My story of being a journeyman painter out of work and forced to carry coal for fifty cents a ton was so heartrending that owners were often glad to help me by giving me painting jobs. Carrying coal and refurbishing damp, dismal cellars were not cheerful occupations for the winter, you will admit."

In the spring, Pupin paid a return visit to the German hotel keeper. He was full of sympathy for the unfortunate immigrant and promised to get him a steady job. Within a few days he had made good his word. Pupin had a position in a cracker factory, working with a squad of boys punching the name of

PUPIN'S BIRTHPLACE

In Idvor, in Banat, Hungary. The house is the first on the left. Pupin left his native Hungary in 1874 to come to this country where he landed with scarcely a cent in his pocket

the company on sweet biscuits. It was not the mechanical act of pressing the name on the crackers that interested him, for that merely required a certain manual dexterity. It was the boiler room in the factory that fascinated seventeen-year-old Pupin.

Early in the morning, before the factory whistle blew, he was shoveling coal, watching the fires, and learning engineering from the fireman. There, in the boiler room, he had his first lessons in engineering. He was puzzling over the phenomena of light and sound, but the boiler-room professor could not shed much light on his difficulties.

A BOILER SHOP SCHOOL

THIS improvised school, with its science department in the basement, had a classical course which was given on the top floor. In a philanthropic attempt to utilize some waste space to the advantage of the workers, the company had made sleeping accommodations in the attic of the factory. Pupin, a homeless waif, lived in this make-shift dormitory. One of his roommates was a crippled German student with a remarkable knowledge of Greek and Latin, a veneration for ancient civilization, and a contempt for modern industrialism. He instilled in Pupin a love for the classics. At the close of the factory day the two machine workers forgot their manual labor during the long mill hours, and recited Latin prose and reveled in the sound of Greek verse.

Naturally under these circumstances, Pupin longed for more education. He had no money to pay for college tuition. But a boy who had taught himself the ways of a new land could find the means to get further education. He did. The factory was his high school. For a science laboratory, he used the boiler room, and for his classical subjects, he had an expert tutor in the German scholar. In his Columbia College entrance examinations he did so brilliantly that he was given a scholarship for the entire four years.

College over, Pupin was offered his choice of a fellowship in either literature or science. His record in both departments had been equally high, but he chose the science.

"When I was a little sheep herder in the old country," Professor Pupin confides, "we used to warn each other about straying cattle by means of signals which we sent by tapping on a knife stuck deep in the hard ground. I had observed that the sound was carried for greater distance through the hard ground than through the air. I could not understand why. It was a problem that fascinated me so that when I had the chance to continue my studies, I selected science in the hope that it might answer my question."

In Europe, Professor Pupin worked at Cambridge and then studied for a doctor's degree at Berlin. Meantime Columbia University, his alma mater, had organized a department of electrical engineering in the school of mines. When Pupin heard of it, he applied for the position. Needless to say a student who had made his brilliant college record, who had won scholarships in Europe, was promptly given the post at Columbia.

A RECENT PHOTOGRAPH
Of Professor Pupin, who now holds the chair of mathematical physics at Columbia University

A PROFESSOR AT COLUMBIA

THE physical equipment of the new department was primitive. There was only a temporary shed, a "cowshed" the students called it, with a laboratory equipment of a dynamo, a motor, and an alternator. It seemed a hopeless prospect to the young teacher fresh from the marvels of European science but his enthusiasm was such as to conquer all difficulties.

"From my studies of the experiments of the European physicists, I concluded that sound, like light, traveled by the vibrations being carried from one wave to the other, reinforced by each wavelength. I believed that by shortening the length of the wave, the sound could be carried further and on this basis I perfected my induction coil. By using three or four coils to the mile on a long-distance telephone wire, the size of the wire could be considerably reduced. Not long ago, a friend of mine, a telephone executive, figured that my invention had saved the telephone company about a hundred million dollars and went on to say that without it long-distance communication could never have been greater than about twelve miles."

PROF. M. I. PUPIN
In 1883 when he graduated from Columbia University

Professor Pupin has not only cradled the art of long-distance telephonic communication but he is responsible for six out of the nine basic radio inventions. In 1895–6, while he was an assistant professor at Columbia and working in the derided "cowshed" laboratory, he evolved an apparatus for electrical tuning and rectification, and in 1902 he sold his patents to the Marconi Company. This fact is not generally remembered.

Professor Pupin, fresh from his European studies, had become much interested in the theories of Hertz, the father of radio, and had begun experimenting with them. At that time, the rectification electrical transmission of sound was not known, the waves brought an indistinguishable buzz which Professor Pupin hoped to make audible. After a year's experimenting, he succeeded.

Sounds which the waves brought could now be understood. But the growth of radio had only just begun. Professor Pupin, who nurtured radio in its infancy, brought it still another step forward. He suggested modifications which transformed these explosive electrical motions into more or less damped oscillations.

All of us know to-day that when our receiver is not in resonance with some particular transmitter, we simply turn a knob to get the desired wavelength. But in the 1890's tuning wasn't so simple. In fact, troublesome wavelengths were one of the biggest drawbacks to the science. Professor Pupin undertook to correct this deficiency. Through exhaustive experiments, he devised an apparatus which superimposed these waves and got them in phase.

"The electrical tuning at the receiving end, as we know it, came into use when Marconi took over my invention of electrical tuning," Professor Pupin explains. "Selectivity was thus introduced into wireless reception and it eliminated some of the objections to the new form of electrical communication. Rectification of the received electrical oscillations by crystals of asymmetrical conductivity, or by my balanced electrolytic rectifier was the next advance."

A TEACHER OF FAMOUS MEN

AS A teacher, Professor Pupin has started many of our most famous radio figures on their triumphant way. At one time three boys were working under him for their doctor's degrees. They were E. H. Armstrong, J. H. Morecroft, now of Columbia University, and Alfred N. Goldsmith of the College of the City of New York. It was in Professor Pupin's laboratory at Columbia that Armstrong successfully developed his feed back circuits. It was in Professor Pupin's laboratory

that Robert Andrew Millikan began his scientific career.

Pupin, this famous teacher of famous men, exhorts boys everywhere to "monkey with their sets."

"The more boys work with their apparatus, the more knowledge of the science of electricity they will obtain, and the more will their interest in the marvels of radio be aroused," he says. "Radio is the coming science, and if its disciples attain as much practical experience and grounding in electrical principles as is possible to crowd into their lives, they can be sure of making progress."

During the war, Professor Pupin did research work for the United States Government in radio communication. His results became government secrets and outside of the fact that his war activities necessitated many trips to Key West, the world knows nothing of his work. As a product of his activity at this time, he helped organize the third arm of our national defence—the National Research Council, an organization of scientific men with headquarters in Washington.

The story of America contains many epics of boys who, beginning at the bottom, struggled to the top, but none illustrates more clearly than this one the chances for a penniless, working boy to achieve a technical education and to become a power in the scientific world.

THE CHURCH
Where Pupin worshipped as a young boy in Idvor

The Way of the Transgressor

A Word About Common Deceptions in the Sale of Tubes, Batteries, Antennas, and Complete Sets—Some Guides for the Tyro Wandering in the Radio Forest

By WILLIAM P. GREEN

Associate Director of the National Vigilance Committee, Associated Advertising Clubs of the World.

PROBABLY the most outstanding instance of outright fraud in radio today, is found in the manufacture and sale of counterfeit tubes, both in tube construction and in fake labels and cartons. The counterfeiting at times would almost baffle an expert.

In some instances former employees of large electrical manufacturing concerns which hold tube patents are ferreted out as members of these counterfeiting rings. They hold forth in secluded spots, sometimes in the rear of a garage or perhaps in a private residence. No signs are in evidence to indicate what is being done on the premises. Frequently the blinds are drawn. In many cases investigators have found it difficult to secure entrance at all, visitors being required to state their business in a front hallway or even out on the sidewalk. As many as eight hundred tubes a day have been manufactured in one of these places alone.

Recently a complaint was made to the National Vigilance Committee that a concern in a middle western city was selling tubes represented to be genuine Radio Corporation of America products, under circumstances that appeared suspicious. Tubes were purchased at the store and forwarded east for examination. This examination showed that the grid, plate, and the glass bulbs were not genuine R. C. A. products. The bases were the genuine article. The use of the base in this way made it possible for the tubes to be sold with every appearance of being a genuine Radio Corporation product.

Occasionally the practice of buying up worn out tubes of standard make, in order to secure the bases, is discovered. Add to the base a counterfeit filament and other essential parts and the finished product has all the appearance of the genuine article. Even the identification mark, such as the well known General Electric circle frequently is counterfeited. The counterfeiting of the cartons and the directions accompanying standard make tubes usually is accomplished by means of the ordinary photographic plate process.

One manufacturer of counterfeit tubes may sell to many distributors. As a general rule the distributor knows what he is buying and when questioned about the tubes he is marketing, he refuses to disclose the source of supply.

The manufacture of counterfeit tubes is, of course, outright fraud. It is not to be classed with many other forms of deception and trickery that put in an appearance.

REPAIRED TUBES

THIS counterfeiting of tubes is one of the handicaps in radio to the removal of which manufacturers and retailers are devoting much attention.

Some concerns advertise that they will repair radio tubes and this raises the interesting point of whether the tube actually is repaired

Truth in Advertising

Is the splendid slogan of the Associated Advertising Clubs of the World, and this forms the second of a series of excellent articles by Mr. Green, an official of that organization, on common deceptions in radio merchandising and advertising, all of which are violations of faith, whether the deceptions are committed intentionally or otherwise. The first of Mr. Green's articles appeared in RADIO BROADCAST for August, 1924, and discussed fraudulent practises in selling complete radio receivers. The Better Business Commission, which is now organized in 36 cities in the United States, has also in some cities taken steps to insure that radio dealers abide strictly by the highest code of professional ethics in their advertising and merchandising. Neither this magazine nor Mr. Green wish to give the impression that the radio business is full of irresponsible and conniving dealers. That there are not more dealers whose methods are not above reproach is remarkable, considering their now large numbers. Every one who buys radio apparatus should be interested in what Mr. Green has to say.—THE EDITOR.

or a new tube constructed on the old base. This question is closely concerned with the patent rights of the leading manufacturers of tubes.

There is one Feaeral decision which holds in effect, that the replacement of a vital part is a violation of patent rights.

Most certainly the filament of a vacuum tube is the vital element of the product (said an official of the Radio Corporation of America in discussing this question). It is the part that emits the electrons, producing the actual phenomenon of detection or amplification. There is no substitute that can be used for this filament. If it is omitted, no results whatever will be obtained. In most so called repair work, the replacing of the filament is not the only thing that is done. A new vacuum must be obtained to permit the electrons to pass from the filament to the plate. The tube, therefore, must be evacuated anew and, as a matter of fact, it costs almost as much to repair certain tubes on a commercial scale as it does to make a brand new product.

L. E. HOLLAND

Who is serving his third term as president of the Associated Advertising Clubs of the World. Himself an ardent radio enthusiast, Mr. Holland has been keenly interested from the beginning in the protection of the radio industry and the public from deceptive merchandising and advertising practices

This question of tube manufacture and repair still is fraught with some uncertainty. The chief interest of the consumer is in the question of whether tubes are genuine or counterfeit, actually repaired or completely rebuilt, and, in any case, whether the result, as determined by actual use, is in accord with the representations made by the advertiser. The average consumer is not much interested in patent rights or infringements. What he wants to know is whether the merchandise he buys is what it is represented to be, in name, quality, and utility.

Still other conditions which vitally affect the public are coming in for consideration. Perhaps the most interesting of these is the cut price situation. Some retailers, as a steady policy, offer sets at prices on which the manufacturers claim the retailer cannot possibly make a profit. These manufacturers do not claim that the merchandise is not always genuine or that it is defective, although many purchases have been traced where such was the case. Their chief contention is that in some instances cut price merchandise is offered as a leader in order to bring the customer into the store as prey for the sale of other inferior goods. Undoubtedly it is true that radio offers a fertile field for certain types of "bait advertising" because of the number of accessories needed with a set. In many cases the total cost of such accessories equals or exceeds the cost of the set itself.

The source of supply of cut price merchandise is a constant problem with the radio manufacturer. Much of this cut price merchandise is secured through indirect channels. The retailer asks some friend in a distant city, who happens to be in good standing with the distributor, to order certain goods which, when received, are relayed to the retailer desiring them. Another source of supply is the overstocked retailer who, when a representative of a cut price store appears on the scene, is glad to unload at a price approximating the manufacturer's.

One retailer, whose chain of radio stores features cut price merchandise, maintains that the radio manufacturer's profits are in proportion to his sales and that the retail price is not a factor in his profits at all.

MORE THAN A SHADOW OF DOUBT

Extravagant claims, which in many instances, actual trial shows to be unjustified, breed certain dissatisfaction and tend to impair the enthusiasm of radio purchasers. The radio public itself should coöperate to require advertisers to tell the truth about their products

"If the manufacturer maintains a sentimental attitude as to how his goods shall be priced by the retailer," he argues, "let him total his cash book at the end of the year and he will find that the radio chain store quite probably has moved one hundred times as much merchandise as the collection of small jobbers."

Careful reading of magazines and newspapers continues to disclose practices which bear out the statement that radio is passing through a period in which the buying public must exercise great caution and discrimination. Take as an illustration a recent advertisement of a well known battery by a retail store. It read——

We are the only dealer in the city in a position to supply the public with unlimited quantities of this

NEW

108 volt B battery

The fact was that this battery, instead of being a new model, was being discontinued. The agency handling the advertising copy explained that the word "new" was intended to mean that the batteries were fresh from the factory and that "unlimited" meant that enough were available to supply the store's trade. Certainly the word "new" in the copy was objectionable because the average reader might well take the advertisement to mean that the manufacturer was bringing out a new model.

THE OVER-ENTHUSIASTIC ADVERTISER

NOW and then advertisers inadvertently get off on the wrong foot. Around the time of the national political conventions, an eastern manufacturer of radio sets advertised in newspapers on the Pacific Coast, urging the public to buy his product in time to listen in. Investigation developed that Kansas City was the nearest point from which the conventions were being broadcast and the feat of reaching that far east from the west coast during the day time, when range of reception is very limited, was anything but a certainty. Again we have the manufacturer of a well known loud speaker, whose advertising in the middle west emphasized the pleasure to be derived from listening in on New York grand opera. It is well known that the Metropolitan company is not heard over the air.

Another case in point is the loose statements made about "noisy batteries." One radio expert to whom the writer talked recently stated that such noise practically never occurs in batteries used for filament supply but that it sometimes is found in plate batteries. The cause is either a defective cell in the battery, or a loose connection between the cells. Almost any dry cell, he pointed out, even those of the most reliable makes, may develop noise when they are nearly used up.

Other extravagant claims are made concerning the life of batteries. This is a difficult factor to determine, and it is here that batteries of different manufacture may be expected to vary materially if at all. Only usage can determine the real utility and life of any particular battery with consideration, of course, for proper care. This is all the more reason why purchasers of radio equipment should give real consideration to the makes and types of batteries they purchase for their sets in order that they may have the maximum protection on the money expended.

Claims for new and startling discoveries in the battery field likewise should be carefully examined. Years of study have brought them to their present point of efficiency and most of the possible improvements could hardly be called revolutionary.

Within the last year one concern has advertised that its batteries will enable the operator of a radio set in the middle west to hear England or South America as clearly as Detroit or Chicago. The advertising copy was so worded as to make it appear that whatever troubles are encountered with a set may be removed by substituting the batteries ad-

vertised for those in use. This is obviously absurd.

Another type of advertising into which the public should inquire carefully before purchasing the goods advertised is that offering various indoor aerials either of the loop or single wire type. Representations that such aerials will equal or outdo the results obtained with an outdoor aerial, regardless of the type of set used, are not always justified, as shown by actual experience in certain locations and under varying conditions. Results obtained at close range may not be possible at all over long distances and it would be well for purchasers to have a very definite understanding that the merchandise may be returned if it does not live up to the claims made for it.

Then again, we often hear mathematics spoken of as an exact science. One might reasonably conclude from this that statements in radio advertising that are based on mathematical calculation could be taken without the proverbial grain of salt. That such is not always the case, however, was demonstrated recently when a well known radio store advertised a standard make receiver at half price, with the added attractive offer that with each purchase an extra piece of apparatus, designed to increase signal strength, selectivity and to improve tone quality, would be given *free.*

Price figures were set out in detail, as illustrated in the following:

List price of receiver	$150.00
List price of extra unit	25.00

Now if the receiver were being sold at half price, and the extra unit given free with each purchase, the customer would have to put on the counter only $75. to be entitled to the complete outfit. On the contrary, however, the price quoted was $87.50. Either the receiver was not being sold at half price or the extra piece of apparatus was not being given free to each purchaser of a set. The advertising agency explained the discrepancy by saying that a mistake had been made in the figures.

BUY CAREFULLY

Radio Broadcast, through its columns, is endeavoring to inform the public concerning practices by reason of which purchasers of sets and accessories should shop carefully. The National Vigilance Committee of the Associated Advertising Clubs of the World recently prepared a resumé of practices which may be useful to the radio public in reading radio advertising and in making purchases on the strength of it. This resumé is as follows:

1.—Appropriation of radio tube type numbers, or any substantial or material part thereof, such numbers having been originated by and become identified with the products of certain well-known manufacturers is a form of unfair competition. Illustrations of such original type numbers are "WD-12", "UV-199" and "201-A" as applied to the tubes of the Radio Corporation of America, and "DV-2" as applied to the tubes manufactured by the De Forest Radio Telephone and Telegraph Company. Tubes manufactured by any other companies should be advertised and sold under their own original and distinctive identification marks.

2.—Sets built by retail stores and containing certain licensed parts bearing the names of well-known manufacturers of sets using the same circuits, should be advertised and sold in such a way as to make it perfectly clear to the public that they are store built rather than factory built. Neutrodyne sets are a case in point.

3.—When a concern seeks to advertise any type of radio product concerning which there is reason to believe that the patent or license rights do not permit the manufacture or sale of the product, the concern should be required to make a reasonable showing that it is within its legal rights and entitled to market the merchandise.

4.—Claims for radio apparatus, such as distance reception, should in most cases be based on average performance rather than some rare, exceptional feat. If the exceptional instance is featured, the advertis-

SPECIAL OFFER
FOR TODAY ONLY

THE SENSATIONAL COLUMBIA REFLEX

At the Unheard-of Price of

$79.50

DOES THIS MEAN WHAT IT SAYS?

In going to a store in response to an advertisement like this, it is important to observe whether or not the retailer has on hand a sufficient number of these sets to fill a reasonably popular demand. Often only one set, advertised as the sample ad above shows, are being offered as bait to get the public into the store. The customer should be careful to see that the accessories he buys with the set are genuine and recognized by the trade as efficient products

WHICH IS GENUINE?

The only distinguishing mark between the two tube cartons cannot be detected in the photograph. The carton on the right is genuine and the one on the left is counterfeit. The tube which came in the counterfeit container was counterfeit. The color of ink on the genuine container was a deeper red than the false one

ing copy should make clear the fact that the same result is not to be expected in average day to day performance. Much disappointment and dissatisfaction may be avoided if radio novices are given some information in advance that atmospheric disturbances, seasons, and other conditions affect radio reception.

5.—Merchandise advertised as being reduced from a certain list price and represented as possessing the list price value, should carry all of the advantages, such as factory guarantees and repair privileges, to which any purchaser who buys at the regular list price is entitled. Otherwise the customer is not getting the complete service or value that is included in the regular list price quoted in the advertisement.

6.—Advertising of radio sets should state what accessories, if any, are included at the price quoted, and if accessories are not included, this should be apparent from the wording and arrangement of the advertising copy.

7.—Claims as to batteries and other accessories should accord with such limitations of performance as recognized scientific opinion in the industry has determined that the purchaser may reasonably expect from a particular type of product. Guarantees, refunds and other sales appeals should be free from the ambiguity or tricks that sometimes make them the source of current dissatisfaction and a future distrust of advertising.

8.—When a set is advertised at a reduced price after the model has been discontinued by the factory, it should not be represented as still possessing its regular list price in a way that leads the public to believe that it is securing a much better current value than actually is the case.

9.—When any particular piece of radio merchandise is featured through advertising as a leader, the concern should be required to have a sufficient supply on hand to fill a reasonable public demand.

10.—Claims for the efficiency of indoor aerials, as compared with outdoor ones should be made with due consideration of the types of radio sets to be operated, distances from broadcasting stations, location of the aerial or loop in the buildings where used, etc.

11.—Advertising of radio devices to reduce station interference should not infer that any number of broadcasters may be eliminated at one time, when such is not the case. Claims of the perfect operation of such devices should be made with due regard for usage under exacting conditions, in that such merchandise usually is purchased by reason of unfavorable location, or out of date receiving apparatus, etc.

12.—In advertising radio accessories, such as dry batteries, which show certain shelf depreciation over a period of time, use of the word "new" should carry with it a clear indication of whether reference is being made to a new model of the article involved, or merely to the receipt of new stock, fresh from the factory.

What Reflex Means

How One Tube is Made to Do the Work of Two—Problems of Reflexing and How They Are Solved—Various Uses of Reflexing—Another Family Tree Diagram

BY JULIAN KAY

THIS article in this series of informative articles about some of the technical phases of radio written in a decidedly non-technical fashion deals this month with the use of reflexing. The patent on the reflex system dates back to February, 1913, when Schloemilch and Van Bronck had their application approved. There are few who have heard something about radio who haven't also heard the word "reflex." Many radio listeners want a good review of reflexing and that is just what Mr. Kay has done. Other articles in Mr. Kay's "What's In a Name?" series have discussed the various classes of receivers in use, radio-frequency amplification, audio-frequency amplification, and the super-heterodyne.—THE EDITOR.

THE old song that "every little bit added to what you've got makes just a little bit more" applies nowhere in radio quite so well as in this reflex business. Given a small pocket book and a long way to go via radio, what is one to do? The answer is to add just the little bit more—and that is what reflexing effectually does.

In the preceeding articles of this series, the various forms of detectors and amplifiers have been analyzed as separate units. Some mention has been made of complete receiving equipment such as the neutrodyne and the heterodyne, both of which are really efficient combinations both of detectors and amplifiers. It is in the latter class of complete receivers that the reflex lies.

The Family Tree diagram on page 672 shows the place of the reflex among radio circuits. It is a combination, a sort of trick combination if you will, of a detector and two amplifiers. The reflex idea may be extended to other complete receiving systems, such as to the neutrodyne, for example in the Fada 160, or to the super-heterodyne as in the Radiola.

The main idea of reflexing is to do away with one vacuum tube, to make one do the work of two. And while it is fairly simple to build a detector and an amplifier as separate units, it is a more difficult problem to build a reflex that works as well as the more complicated apparatus it replaces. Unless the reflex is correctly constructed from tried and true methods it will lose as much or more than it gains—a state of affairs that is not true economy.

Fig. 1 shows the general scheme. Energy from the output of the circuit is fed back into the input so that the apparatus involved does double duty. The necessity for the frequency changer lies in the fact that one cannot perform this feeding back stunt without having something happen—a something usually made evident by howls and groans. In other words, the amplifier oscillates.

A SIMPLE FORM OF REFLEX

A SIMPLE form of reflex with which everyone is familiar is the well known "tickler" feed back affair. In this case, shown in Fig. 2, some of the radio frequency energy is placed in the input again by means of a coil inserted in the output or plate circuit. If the tickler is brought near enough to the secondary coil, the system oscillates. The remarkable amplification that results just before oscillation takes place is well known.

If the same scheme could be applied to audio-frequency amplifiers, much more amplification

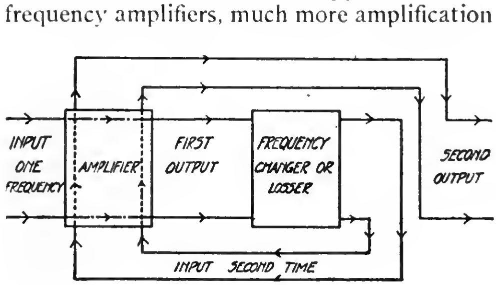
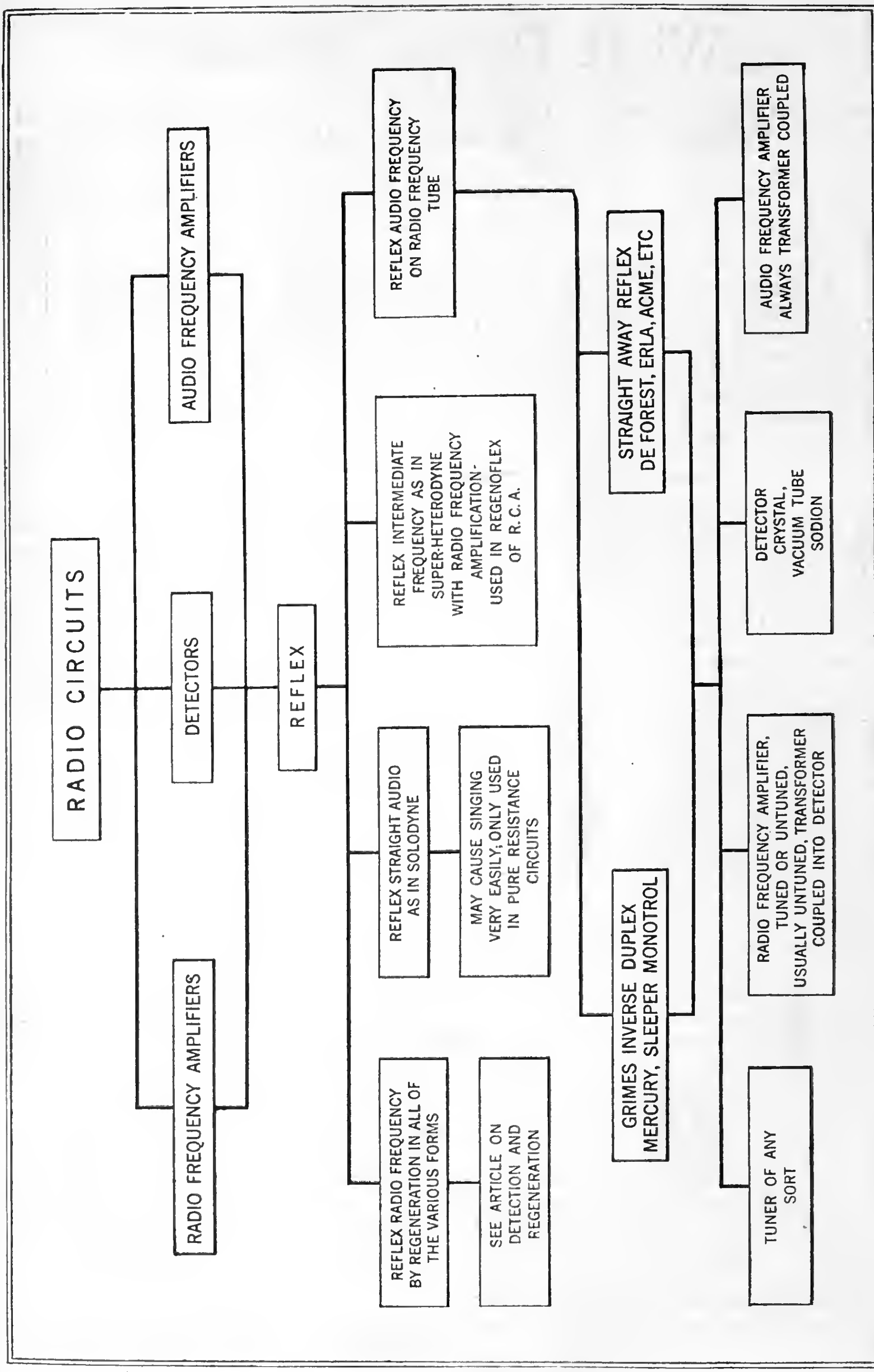


FIG. 1

The reflex idea. The main idea in all reflex circuits is to make one tube do the work of two



THE FAMILY TREE FOR REFLEX CIRCUITS

might be expected. Here, however, we are dealing with a different problem. In the tickler case we are interested in a very small percentage of the total frequency, that of the incoming signals, say one million cycles. The tuning is so adjusted and the position of the tickler so arranged that oscillations over this comparatively narrow band can be controlled.

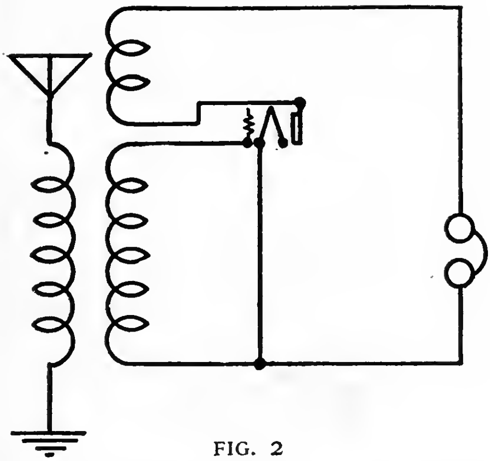


FIG. 2

One of the simplest forms of reflex and one of the best known. The coil in the plate circuit is known to all users of regenerative sets. Some of the radio frequency energy is fed back again through the tickler coil to the primary circuit

In audio-frequency amplifiers, however, we are interested in the uniform amplification of the whole band of frequencies from fifty to several thousand cycles. If the tickler were adjusted for one particular frequency, oscillations would probably occur at another. For code reception where all signals can be brought to a single audible note, say 1000 cycles, the audio amplifier may be made to regenerate in this fashion with remarkable results.

In the case of the resistance-coupled amplifier, as illustrated in Fig. 3, part of the output energy of one tube is sent around the circuit again. There are certain precautions that must be taken before such a scheme works, precautions with what the engineer would call the "phase relations." In general such feed back is undesirable because of the difficulty in controlling the system.

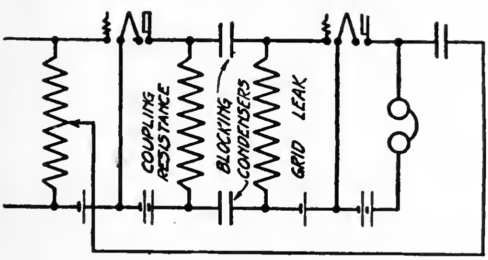


FIG. 3

Reflexing in a resistance-coupled audio-frequency amplifier

WHEN AMPLIFIERS OSCILLATE

AUDIO-FREQUENCY amplifiers very frequently do oscillate, a result of some undesirable coupling between the output and the input. A high pitched squeal may betray this state of affairs, but often the oscillations take place at a frequency above audibility. Lack of amplification and some distortion is the result. It is for this reason that all grid and plate leads in multi-stage amplifiers should be as short and as far apart as possible.

In practice, then, a frequency changer follows the amplifier that is to be reflexed and it is the greatly changed frequencies that are returned to a preceeding part of the circuit to go the rounds again. Fig. 4 shows the general principle. Incoming signals are sent through a radio-frequency amplifier where they are boosted in amplitude. They are then changed in frequency by the detector and are sent back to the first amplifier. This first tube, as in the Roberts Knockout circuit, has currents of two widely different frequencies flowing through it—so widely different that no interaction occurs. For instance at 300 meters the incoming signals have a frequency of around one million cycles, at least one hundred times greater than any audio-frequency tone that will be amplified.

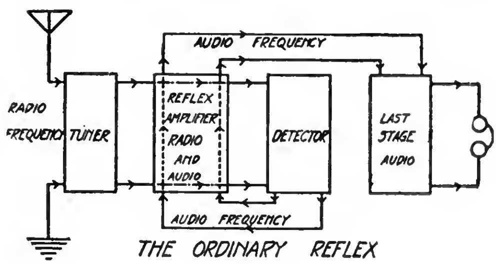


FIG. 4

A schematic diagram of the application of the reflex principle to a common type of circuit. The paths of the various frequencies are made quite clear by the arrows

The detector may be any one of the various forms. Quite often a crystal is used, although louder signals will result from using a tube detector. The crystal is somewhat tricky in adjustment, a fact that has some bearing on the tuning and upon the quality of signals, as will be explained later.

The advantage of the reflex trick is obvious. With two tubes, one used as a detector and the other functioning as both radio- and audio-frequency amplifier, we get results equal to that when three tubes are used. This reduces the first cost of the set by one third and at the same time decreases the space required as well as materially lessening the battery upkeep.

REFLEXED SUPER-HETERODYNE

ONE of the best examples of reflexing is that performed on the super-heterodyne. Fig. 5 shows how the idea is applied. Following the first amplifiers, the frequencies are materially reduced by means of a detector and are then fed back into the amplifier whence they go to other intermediate-frequency amplifiers. Another stage of reflex might be applied as the dotted lines show, but the trouble from oscillations and from overloading probably would not warrant this decrease in tubes.

THE INVERSE DUPLEX

THE Inverse Duplex credited to Grimes is a good example of a complicated reflex, as shown in Fig. 6. In this case radio signals are amplified twice. Then the detector output of low frequency is fed back into the second radio amplifier, thence into the first radio amplifier and finally into an audio stage all its

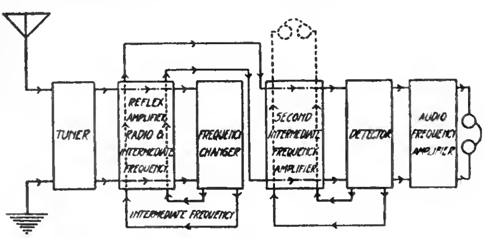


FIG. 5

A schematic diagram of the Radio Corporation reflexed super-heterodyne. Some very delicate and rather difficult technical problems are involved in making a circuit of this sort commercially practicable, but it was done by Messrs. Armstrong and Houck of the Radio Corporation

own. The "inverse" idea comes from the fact that the second stage of radio is the first stage of audio, and the first stage of radio is the second of audio—just try and figure that out!

Other reflexes are shown on the Family Tree diagram and do not differ materially from those described.

REFLEX TROUBLES

THE only advantages in the use of reflexing lie in the economy of apparatus and space effected. Electrically there is no advantage in performing three operations in two tubes in place of three. In fact, unless considerable care is taken, there are several disadvantages. For the fan, however, who is cramped for funds, who wants to get "just a little bit more" out of his apparatus, the reflex is the thing. RADIO BROADCAST has taken considerable pains to perfect the Roberts circuit which works and works remarkably well. By following the detailed directions that have been given for its construction, any one can have

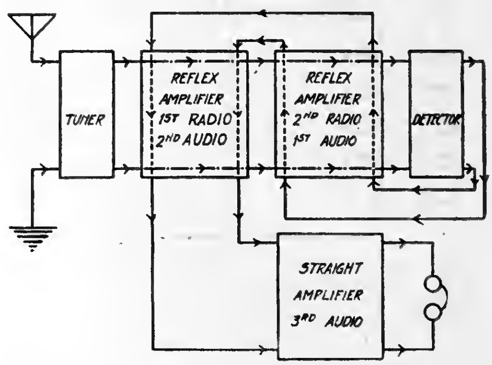


FIG. 6

The inverse reflex system usually known by the trade name as the "inverse duplex"

an unqualified success with the circuit. The other fellow has done the experimenting on it, it is now on a *pro bono publico* basis.

There are several inherent disadvantages in the reflex scheme. In the first place there are currents of widely different frequencies in the amplifier tubes. It is not the fact that these frequencies are far apart that matters, for therein lies its success, but the fact that the tubes are doing double duty. Their plate circuits are traversed by two currents, either of which may be enough to overload the tube.

Receiving from a local station may cause the entire straight portion of the tube "characteristic" to be used. Addition of more voltage from any source may cause the curved portion of the characteristic to be used—and this means modulation or distortion.

Overloading is particularly liable to take place if high ratio transformers are used. This effect was described in the article on audio-frequency amplifiers in RADIO BROADCAST for November, 1924. The remedy, of course, is the proper C battery and a lower turn ratio. As far as the writer knows there is no very high ratio transformer on the market to-day with a proper characteristic, so that one is safe only by avoiding the "10 to 1" coils.

Another defect is the introduction of high

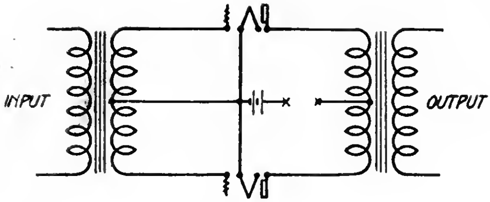


FIG. 7

The usual push-pull audio-frequency amplifier circuit. A special case of the push-pull circuit is discussed in the accompanying article

resistance into the various circuits, either through the transformer winding or by the crystal detector. This makes tuning broad, and in the crystal case it makes the tendency toward oscillation somewhat greater. For this reason, potentiometers are used to make the amplifier grids positive—a bad practice at best. Every adjustment of the crystal changes the resistance in the circuit, and necessitates readjustment of other parts of the set. Under certain conditions better signals may be obtained by removing the crystal contact, a sure sign that something is wrong. Often a point may be found that gives loud signals which if used in an ordinary crystal circuit would not be sensitive at all. This is due to the semi-regeneration which occurs in the circuit and is caused by the crystal resistance.

THE PROPER TRANSFORMERS

PROVIDED the ratio is not too high and the resistance not too great, any good audio transformer may be used in reflex circuits. Here as in any other audio amplifier circuit, only the best transformers should be used—if one is interested in quality as well as quantity. Much depends upon the proper value of by-pass condensers, and the poor quality emanating from some reflexes may be traced to these small components.

For example, a small condenser placed across the secondary winding of an amplifying transformer has the same effect as a large condenser shunted across the primary. The result is that high frequencies find a ready path through this effective primary capacity, and they naturally refuse to bother going through the transformer. The average transformer is a poor device anyway beyond 3000 cycles and when shunted by a condenser of too large a capacity it misses most of the high notes.

The coming year promises much in the way of good transformers. The writer has seen one new coil that will probably be on the market by the time this is being read and doubtless others are being perfected. The overall amplification of this transformer and a UV-201-A tube is far beyond that attained at the present time in the point of equality of amplification over the audio band. The future of radio seems to point toward better and better reproduction, a future that will be present as soon as more nearly perfect transformers are for sale.

PUSH-PULL REFLEX HOKUM

DURING the past year, the writer has seen several articles on how to reflex a push-pull amplifier. Enormous amplification is claimed, as one might suppose from getting two tubes to act as four. Who couldn't get signals loud enough to stop the clock with a four stage amplifier, one of which is push-pull? What is wrong with this scheme?

Fig. 7 is the conventional push-pull amplifier. Between the B batteries and the output winding are two "X's" which should normally be connected together. Now the great advantage of the push-pull amplifier connected as shown, lies in the fact that all of the distortion due to overloading is balanced out, appearing only at X and not in the output. If one placed his receivers at X he would get all of the distorting harmonics and none of the fundamentals.

Fig. 8 is one of the reflex schemes. The normal output is fed back into the input as

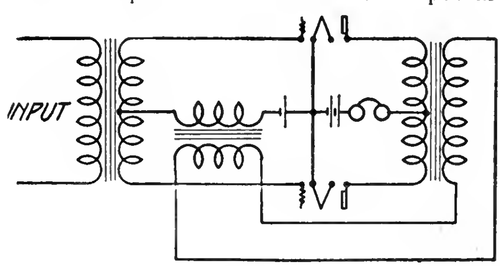


FIG. 8

A reflex scheme which has been exploited to some extent which contains a serious technical flaw explained in the article

shown and the receivers are placed where the distortion is greatest. Another scheme is to interchange the output coil and the receivers, thereby sending the distortion around again. In either case the amplifier will probably howl, and should if it does not, for here is a straight case of feeding the output back into the input without the usual ceremony of changing frequencies! Other ideas, fully as unnecessary, have appeared for reflexing the push-pull, transformer arrangement as if it were not valuable enough by itself.

JUST BEFORE ELEVEN O'CLOCK

On the first night of the International Radio Broadcast Test at Mitchel Field, Long Island. Under command of Capt. H. M. McClellan, men of the 5th Observation Squadron, U. S. Air Service, set up special radio receiving and transmitting trucks shown in the photograph. Communication was maintained with the laboratory of the magazine by short wave radio telephone and code. Various stations in England, France and Radio Iberica, Madrid, were heard here

The International Radio Broadcast Test of 1924

A Review of the Second Annual Test Between Europe and America—What They Proved Socially and Technically—Sidelights on the Event Which Interested Nations

BY ARTHUR H. LYNCH AND WILLIS K. WING

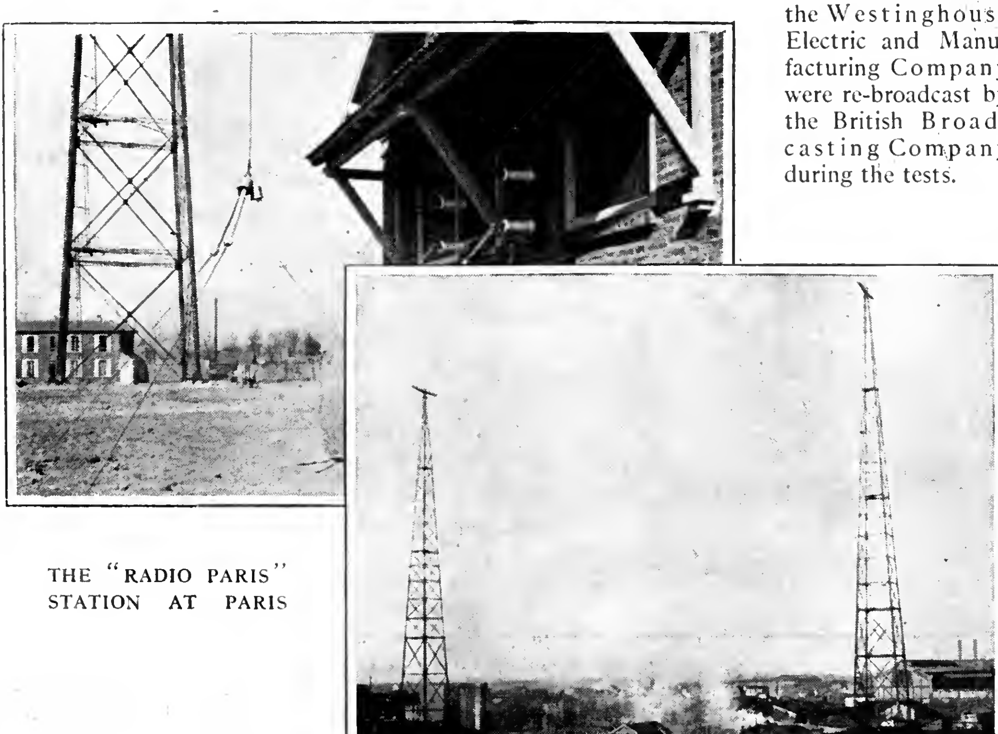
THE thousands of letters, telegrams, telephone calls, and personal messages which we received during and after the International Radio Broadcast Tests, concluded a short time ago, proved conclusively that the signals from foreign broadcasting stations were heard in every nook and cranny of the United States. Reports came with surprising accuracy and regularity from California and Oregon as well as New York State and Maine.

The average moderate-sized house has, perhaps, twenty-five forty-watt electric lamps to light it, which consume about one kilowatt of energy. Consider, then, that these avid and enthusiastic radio listeners who strained at their receiving sets each night of the tests were trying to pick up signals from transmitting stations using a power equivalent to that consumed by about fifteen forty-watt lamps, and then marvel, as we all do, that the foreign broadcasts were so generally and so well heard.

Marconi, when he hoisted his kite aerial near St. Johns, Nova Scotia, on December 6, 1901, used twenty-five kilowatts of power in trying to push the historic letter S across the stormy reaches of the Atlantic. The English and Continental broadcast pioneers, A. D. 1924, were using five hundred watts, less than one fiftieth of that power! It took Marconi weeks of effort to record the signal S, with no other obstacles but natural ones and the crude receiving apparatus at his command. North American listeners were trying to hear foreign programs with receiving sets of advanced design, it is true, but against great odds. Your listener, in 1924 not only had the difficulty of unusually unfavorable natural conditions, but he had to cope with man-made interference which is well-nigh impossible to overcome, in the form of squeals and howls from improperly designed and operated receivers, which were so pernicious in almost every locality you could name, that receiving with any great degree of success was nearly impossible.

It is safe to say that every one of the broadcasting stations in Europe and England was heard at one time or another during the tests while but few of the American stations were heard abroad. Those that were heard were using power considerably above the average. Inasmuch as the average European transmitter is not capable of any greater range than the transmitters used here, it seems reasonable to assume that our receivers are more sensitive than those used by the average listener in foreign countries. It will be remembered that but few of the European stations were heard in this country last year, which would seem to indicate that we have improved our receivers very materially during the past twelve months. Within the next year one can assume that additional improvements will be made in receiver design. It is also probable that high-power broadcasting stations, now being seriously considered, will result in much better reception of our programs by foreign listeners.

When a receiver is made more sensitive, it is more susceptible to interference as well as more responsive to the signal desired. It may, therefore, be desirable to use greater power for broadcasting of this nature. Then, too, there is the possibility of broadcasting on short waves for the purpose or rebroadcasting in a distant locality or foreign country. A very excellent indication of the progress being made in this direction may be seen from the success with which the programs from KDKA, the Pittsburgh station of the Westinghouse Electric and Manufacturing Company were re-broadcast by the British Broadcasting Company during the tests.



THE "RADIO PARIS" STATION AT PARIS

With the logical assumption that more powerful American signals will be available in our tests next year, it is probable that American programs will be more generally heard abroad than they were in 1924. And when we assume that perhaps more power will be available from broadcasting stations abroad and that our receivers will be improved in design and operation alike, completely satisfactory international broadcasting will without question move another step nearer.

RECEPTION IN THE UNITED STATES IN 1923 AND IN 1924

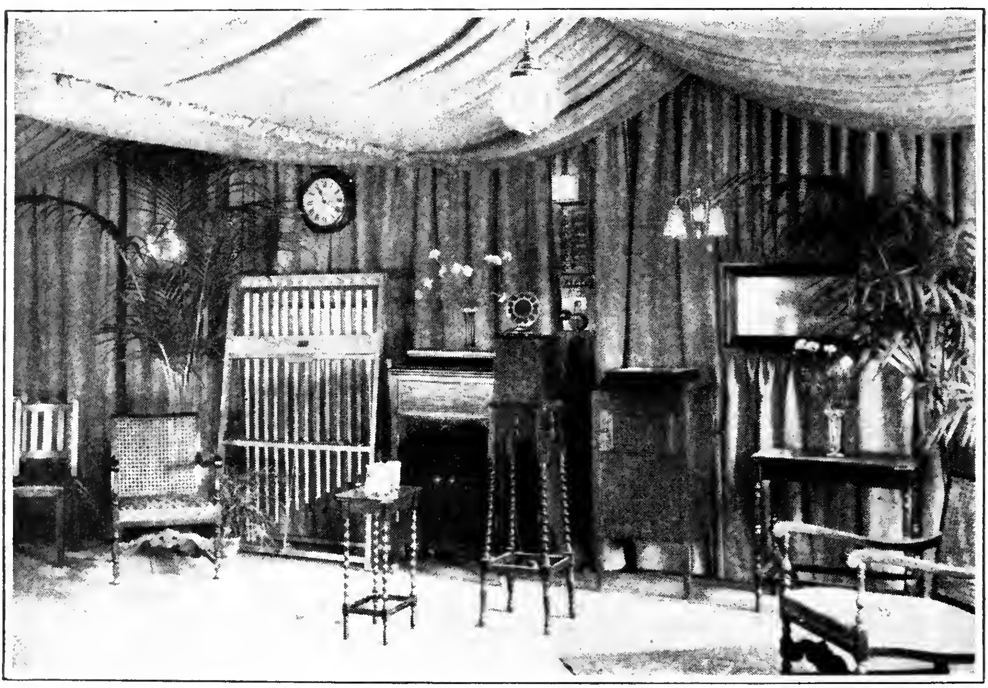
WE HAVE been asked how reception in North America during the tests this year compared with that of last year. In 1923, the English stations were reported in every section of the United States and in many parts of Canada by relatively few listeners. This year, the English and Continental stations were reported by literally thousands and thousands of listeners in every part of the nation. Many more cities and towns were represented. The difference may be laid, first to the hearty coöperation of American, Canadian, Mexican, Porto Rican, and Cuban broadcasters in keeping off the air during the foreign transmission times. Secondly, receiver design has improved, and thirdly, the owners of those receivers have grown more expert in their operation.

As a striking example of what can be done in the future, the reception of Mr. F. R. Hoyt, of Stamford, Connecticut, is of considerable importance. Each evening of the test, he brought in the foreign programs with such volume that he was able to make phonograph records of them.

A listener on a small island off Beverly, Massachusetts, where there were no radiating receivers about, carried foreign programs almost without interruption until the distant announcer stepped away from his microphone and closed the program.

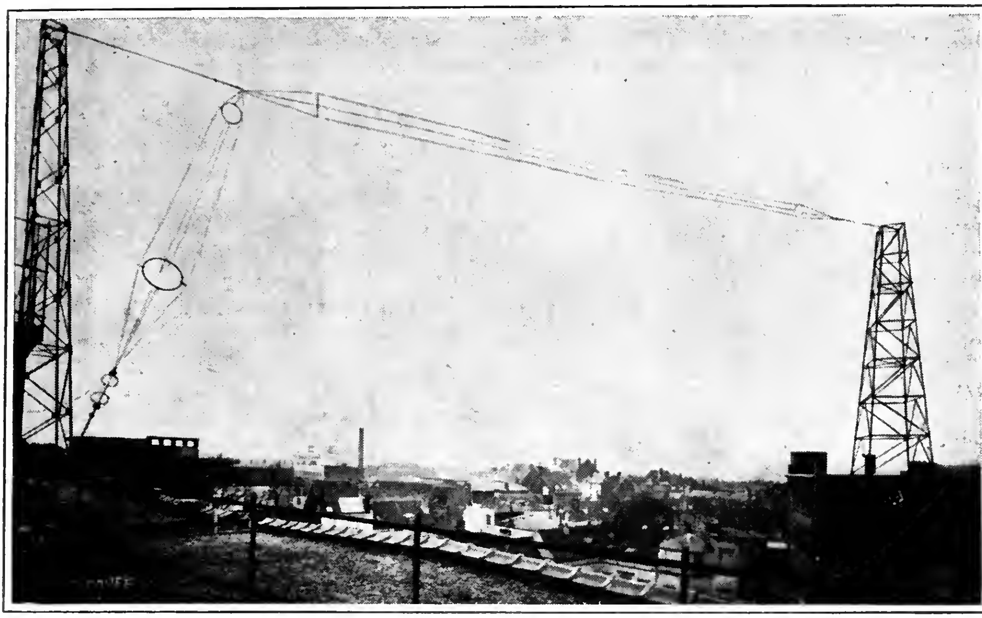
Several listeners of Maumee, Ohio, a suburb of Toledo, on several occasions received the foreign stations with clarity that they were able to put the loud speaker near the telephone which was connected by long-distance lines to our office in Garden City, nearly seven hundred miles distant. We heard a part of the program picked up from Madrid and Paris.

One of our readers who used a Knockout



THE STUDIO AT BOURNEMOUTH, STATION 6 BM

The signals from this station, operating on a wavelength of 385 meters were generally heard all over this country. The installation here looks more like that of the average American studio because the apparatus is that of the Western Electric Company



STATION SBR BRUSSELS
Signals from this station, on 265 meters were reported as far west as Denver, Colorado

four-tube receiver at his home on Long Island received Madrid every night they broadcast with intensity enough to permit a group of his friends plainly to hear their programs through the loud speaker.

Verified similar instances of just this sort occurred times without number all over the country as any reader may discover by inquiry in almost any radio group.

THE COMMUNICATIONS AT HEADQUARTERS

HAD the announcements from foreign stations been more frequent, the total number of verified North American listeners to those stations would without question be enormously increased. Many heard fragments of programs and even one or two complete musical numbers but the station faded out before the announcement was made. This made the work of verification at our office much more difficult, because the foreign stations were transmitting between four and five o'clock in the morning their time, and it was obviously very difficult to get many artists at their studios at that time. Their programs depended much on the ingenuity of the studio manager. Most of the selections broadcast from the English stations were phonograph records of well-known operas, although organ music was sent from several of the English stations during the early nights of the tests.

Very general good sportsmanship was shown by listeners on this side who heard programs on wavelengths on which no American stations were sending. These listeners wrote us, wired, and telephoned about the signals they had heard, but made no effort to claim reception when they had not intercepted a definite announcement.

But there were other sides to the communications. "Last night, at 11:20, I heard a woman singing a soprano solo. What foreign station did I hear?" was a question asked more than once, probably in all seriousness. A radio enthusiast in Costa Rica wrote in that he had heard nothing about the tests until on the second night, he heard announcements from several American stations. Accordingly, he tuned-in on the foreign wavelengths and heard the test programs in succession from both continents. Another listener in Denver, Colorado, wrote in to ask what American amateur station was using the call letters 5 NO, saying that he heard a radiotelephone program whose operator used that call. It should be remembered that American amateurs use call letters beginning with numerals.

THE ARRANGEMENTS IN ENGLAND

THE burden of making the extensive and difficult arrangements for the tests on the Continent and in England fell on the capable shoulders of Hugh S. Pocock, editor of the

Wireless World and Radio Review. Mr. Pocock, working with the British Broadcasting Company in the tests of 1923 made the complete arrangements then, and coöperated with them in verifying reports and in answering correspondence with the great number of interested British listeners. This year, his problem was a vastly more difficult one. Arrangements with scattered broadcasting stations on the Continent had to be made. Programs were finally arranged with stations in Spain, France, Belgium, Italy, Denmark, and Germany, and difficult problems were excellently solved. Working in close coöperation with him was Captain A. G. D. West, assistant chief engineer of the British Broadcasting Company, and when Captain P. P. Eckersley, chief engineer of that company, returned from his trip to this country to attend the Hoover Radio Conference in Washington, he, too, lent his valuable aid.

CAPTAIN H. M. MC CLELLAN

—United States Army Air Service, at a special super-heterodyne loaned him by RADIO BROADCAST. This is the same "super" which was successful in reaching out to London and other English stations in the transatlantic tests of last year. This receiver brought in Madrid, Bournemouth, Newcastle, Cardiff and Paris this year

North American listeners owe a great debt to the broadcasters abroad who sacrificed their rest for seven nights and sent programs from four to five A. M. It was no small task to maintain their regular schedules and to make the necessary arrangements for the special late test programs as well.

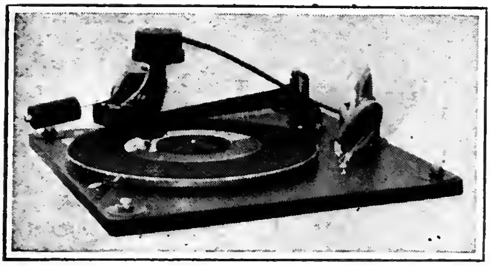
The operators at the high-powered transatlantic stations of the Radio Corporation of America at Carnarvon, Wales, and at Christiania, Norway, listened for American broadcasting, and were successful in hearing many complete programs.

ARRANGEMENTS IN THE UNITED STATES

THE first task on this side was to secure the coöperation of the five hundred and fifty American broadcasters. This meant the sacrifice of probably their most valued program hour to allow listeners here a clear ether for the foreign signals. Without notable exception they agreed to make every necessary arrangement. In Canada, Mr. Jacques Cartier, director of station CKAC, *La Presse*, at Montreal undertook to make arrangements with the fifty-odd stations north of the border. Coöperating with him were the independent stations and the large chain operated by the Canadian National Railways. In addition, the Cuban Telephone Company aided, with their station PWX, as did other Cuban broadcasters. Station WKAQ, at Porto Rico, also joined in the arrangements. The stations of *El Excelsior* and *El Universal* in Mexico City helped as well.

Among the organizations who lent their best efforts toward the success on this side were the United States Army Air Service, who extended their facilities at Mitchel Field, Long Island, the General Electric Company, who gave complete information about the tests through their various stations. In transmitting periods from this side station WGY made all their announcements in five languages to make identification of their signals easy for foreign listeners. The Radio Corporation of America had the operators of their high-power stations listen for foreign broadcasting, and the staff at their Chatham station turned in several complete logs of reception. The broadcasting stations of the Corporation took a very active part in the tests as well. In addition, the Westinghouse Electric and Manufacturing Company gave the full support of their stations and on at least one night, programs from KDKA were re-broadcast in England for listeners there. The Radio Trade Association, the American Radio Association, the National Association of Broadcasters, the Esperanto Association, and the Ilo Association were most effective in their respective fields.

Newspapers throughout the country were most active in covering the tests as a piece



THIS DEVICE RECORDED FOREIGN BROADCASTING ON A DISC RECORD

A series of thirty records was made by Mr. F. R. Hoyt, of Stamford, Connecticut, using this method of recording the signals. These discs show very plainly how considerable was the interference effected by the users of oscillating receivers. Some of the foreign signals recorded came through with great volume

of important international news. Practically every paper listed local test listeners who heard the foreign stations. Radio editors of many of the dailies were in touch with our offices by telegraph and telephone exchanging information. Some very complete and careful logs and reports came to us from a number of radio editors who took great personal interest in the tests.

Almost a thousand manufacturers of radio receivers were assigned official numbers and acted as official receiving stations and were most helpful in submitting reports of their reception. And other manufacturers sent receiving equipment and in some instances sent engineers to install and operate it, at our headquarters, at Garden City. These receivers were successful in many instances in picking up the foreign stations and, by means of liaison maintained between them by special buzzer circuits put up for the purpose, it was possible for several receivers here to keep an accurate log of several foreign stations at the same time. These logs were very valuable in checking the reports from listeners throughout the country, which began coming in by telephone before the hour for receiving was completed.

AT GARDEN CITY

THEN, too, it was possible for us to keep in touch with the three receiving sets operated at Mitchel Field by means of the short wave transmitter, which was loaned us by the Radio Corporation of America for that purpose.

Many of the manufacturers, who had accepted assignments to act as official listeners, went to no end of trouble to see that their work was effective. In several instances they had receivers installed in four or five different locations and arranged for telephone communication between them, in order that each would have a check on the others and so that the reports of reception could be wired to Garden City as soon as practicable.

The Western Union Telegraph Company and the Postal Telegraph Company made great effort to see that listeners knew where to wire their requests for verification of foreign broadcasts before the tests actually took place. The former organization went to the trouble of distributing more than two million circulars, telling people how to route their telegrams to us, in order to expedite their delivery.

Several manufacturers offered prizes for the best reports of reception of the European stations with receivers of their manufacture and in one instance they called upon us to pick the winner.

Many of those who took part in the tests last year will remember that the listening periods were only half an hour in duration, while this year the much more satisfactory period of one hour was put into effect. Next year we hope to have the test so well organized that no hitch whatever will arise and it is probable that a representative of RADIO BROADCAST will visit Europe in order to arrange the programs, so that a check of the broadcasting carried on during any test period will be found in the papers throughout this country and Canada the next morning. We

©Underwood & Underwood

A SILVER CUP

Was presented by J. D. R. Freed, president of the Freed-Eisemann Company to Mrs. Edna M. Smith of Springfield Gardens, Long Island, the first listener using one of the receivers manufactured by that company who heard verified foreign signals

hope to arrange a program which will be adhered to very closely, on which there will be a very close time check and it is very likely that the European broadcasters will make much more frequent announcement of their call letters and location, since the shortcomings of this year's effort have been brought to their attention.

It is very likely that with a year in which to make our preparations and inspired by the great success we have had this year, it will be much simpler for us to enlist the aid of those who have, up to now, been somewhat luke-warm concerning the interest they believed listeners would take in tests of this nature. What more conclusive proof could there be of this interest than the fact that hundreds of thousands of us, everywhere in the North American Continent, Europe, and Australia, spent approximately two hours each night for a solid week listening to (or in some cases just listening for) stations in other lands?

THE RESULTS

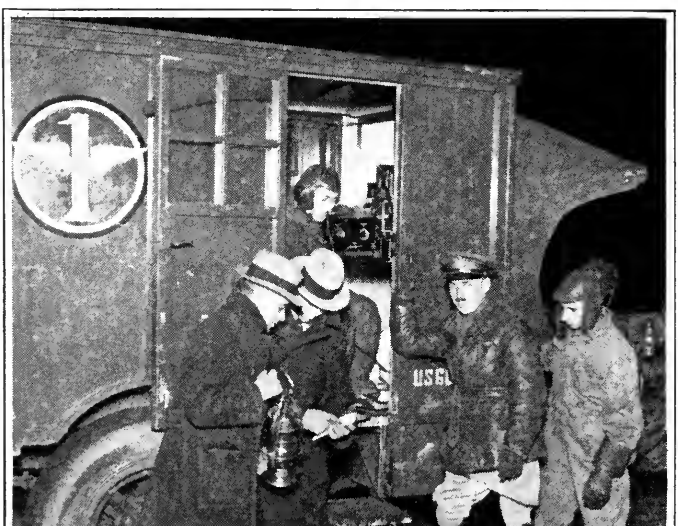
THE International Radio Broadcast Tests interested great numbers of people who had yet to be convinced of the possibilities and benefits of radio. They showed to practically every listener that the menace of the radiating receiver is so serious that some definite, militant, and constructive measures have got to be taken in the very near future to protect radio receivers and to give listeners an air clear from artificial, unnecessary, and absurd man-made interference. And, too, they brought listeners on this continent a little closer to their brothers across the sea.

We have long talked in beautifully figurative language about "hands across the sea," but now in a very real sense we have voices across the sea. No matter now if the voices could not deliver any very complete message. It is enough that one entire continent was listening for another, that radio folk grew to think even for a short time of those on the other side. The start has been made, and in the years of progressive technical experiment, trial and error to follow, we shall get nearer and nearer to nations which before had been but names on a complicated map, or dull words in a newspaper story.

The important thing is that the effort has been made, that the electrical ice has been broken. The task is the engineer's now, and in his capable hands we can well leave it. It requires no glib gift of prophecy to think of close radio unity in future years with every nation of the globe.

Hon. Alejandro Berea, the Consul General for Spain at New York, in an address recently made at a luncheon attended by a number who participated actively in the direction of the International Tests phrased very well his conclusions about the tests:

> I most heartily congratulate the organizers of this communication across the Atlantic, and I am sure that the spiritual compenetration between Europe and America will be thoroughly perfected within a short time by the use of scientific transmitters and receivers; and Spain, on account of its geographical position and because it is one of the nations of continental Europe nearer to this country, will be one of the first to avail itself of the benefits of broadcasting and be in contact with America, which is bound to it by the ties of ethnography and history.

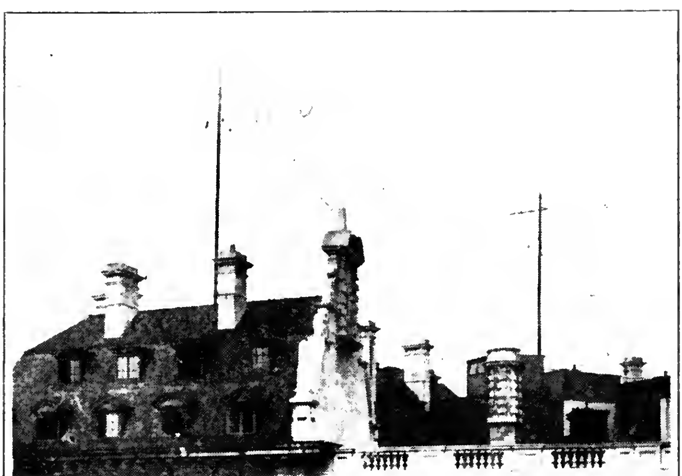


A CLOSE-UP OF ONE OF THE ARMY RECEIVING TRUCKS

At Mitchel Field, showing the receiver and transmitter installed and a group of officers and men. Capt. McClellan is holding to the iron strap on the truck. The night this photograph was taken it was extremely cold, and there was no illumination except that furnished by lanterns and flashlights. The officers took the radio truck out to the center of the landing field, away from all obstructions and listened for the foreign broadcasts, which they heard, at times badly interrupted by blooping receivers

IN CHARGE OF CANADIAN COÖPERATION

For the International Radio Broadcast Tests was the staff of station CKAC, *La Presse* Montreal. J. N. Cartier, the fourth from the left in the last row, director of the station, completed his arrangements with brother Canadian broadcasters for participation in the International Tests. In the back row from left to right are Arthur Dupont, assistant announcer; Adrien Arcand, radio editor of the paper; Leonard Spencer, technician, J. N. Cartier; A. Lebeau, master of ceremonies; Front Row, J. P. Calligan, "Father Radio"; Mary Brotman and Nora O'Donnel, stenographers



THE NEW ANTENNA AT 2LO

The London station of the British Broadcasting Company. A good part of the English programs during the tests were simultaneously broadcast from this studio through the various other Island stations, linked to London by wire

The Listeners' Point of View

Conducted by Jennie Irene Mix

What is Going to Happen to Radio Advertising

PERHAPS this much discussed question of advertising by radio will ultimately be settled by the advertisers themselves. They may find that the returns in sales in no way measure up to the amount expended in getting the name, and in some instances a description of their product, to the radio public. And, again, even under these circumstances, they may keep right on engaging broadcasting privileges at so many dollars per minute, just as they keep on sending out sales letters although not more than a half dozen out of a hundred letters usually bring returns.

One feature of this question, however, seems bound to be settled but one way. This is, giving the listener-in the privilege of knowing that advertising is about to be broadcast. Of course, when a musical organization or a monologuist bearing the name of a well-known commercial product is announced, that is easy. Twist the dial if you do not want to listen. But when a man is announced as a speaker on "The products of the Province of Paragon in Paradisio," with but a murmured postscript, "Mr. Blank is pleased to take advantage of the facilities of this station to talk to you," then, beware! You may listen quite a time before you catch on to the fact that Mr. Blank is telling you about these products because he wants you to buy them.

The radio audience will eventually take care of this unjust manner of radio advertising. They will tune Mr. Blank out, and they will do this to such an extent that even the low average of returns from sales letters will seem to him, in comparison, an almost alluring margin of profit.

It is these veiled advertising talks, and not the performances of orchestras, singers, and monologuists, that arouse the ire of the listener. When "The Gold Dust Twins" are announced, or "The Eveready Quartet," and other organizations or individuals broadcasting wholly for advertising purposes, that is a straight-from-the-shoulder game. It is offered you with no subterfuge back of its promotion. You may take it or leave it, as you please. And, in all fairness, it must be acknowledged that very often these performances put on by commercial houses to advertise their goods are superior in quality to similar attractions not paid for by advertisers but put on the broadcast program by the director who must choose his talent from the hodgepodge group of people he may be able to persuade to work for him for nothing.

The plea of the broadcasters that they cannot afford to entertain the public for nothing, and therefore they must accept advertising numbers for which they are paid, does not make any impression on the intelligent portion of the radio public. No one asked these broadcasters to erect and operate their station. A goodly number of them could go out of existence overnight and no one would complain. Many, indeed, would rejoice! This because, with some few and notable exceptions, all the stations put on the same character of programs, cheap enough, at best, and ones that are given with the same uniform mediocrity of performance. These broadcasting stations are maintained for the purpose of reaching the largest number of people possible, rather than with the desire ever to make an appeal to a discriminating public.

CARYL MARSHALL, SOPRANO

Who recently was heard through station WGY. Miss Marshall was one of the winners in the Juilliard Scholarship test held in New York not long ago, and in which were entered competitors from all over the country

The attitude of the directors of such stations is, to a degree, similar to that of the merchant who sells to all classes of people because this is the sensible way in which to conduct business. But the wise merchant keeps a quality of goods that will appeal to customers of refined taste, the while he also has a "bargain basement." Yet the same merchant will go to the enormous expense of installing and maintaining a broadcasting station to advertise his store, and then permit the director of that station to put on programs that appeal only to "bargain basement" customers. Poor advertising, this!

The owner of a broadcasting station that permits paid advertising has a strong argument in his favor when he wishes to defend himself. He can justly say that, only as long as no one is paid for broadcasting, every number on every program is in the nature of advertising. He will tell you that the persuasion brought to bear in order to get contributors to programs is that their names going out over the air to countless listeners is a rich source of advertising. And so it is, provided they prove worth the hearing.

During the last two months an increase has been noticed in the number of good musicians of fairly wide reputation who have broadcast. To be sure, their number is so small compared with the mediocre talent presented that they are all but lost in the mass. But they have been heard and greatly enjoyed. Perhaps some, or all, of them are paid. We have a very strong suspicion, pretty well justified in one or two cases, that certain stations are growing tired of giving programs by "microphone pluggers," as they are designated in the studios, and are engaging the best talent available in their vicinity and paying for it.

To a director who desires to put on fine programs and cannot do so because the company for which he works will not give him any money for this purpose, it must be a godsend to find promoters of public concerts who are willing to have their attractions broadcast. The best stations, so far as the present writer's knowledge goes, never miss such a chance. This shows what sort of music they would give the public if they had money to engage good artists.

LEON ROTHIER

One of the greatest operatic bassos ever heard in this country, and who has for many years been with the New York Metropolitan Opera Company. He is here seen broadcasting from station CKAC, Montreal, prior to a concert given in that city

Among the features of this character that have recently lifted radio music above its accustomed dullness, are the concerts of the St. Louis Symphony Orchestra broadcast by station KSD, and commented on in this department last month. Others of notable quality are the Wednesday night programs of the New York Philharmonic Orchestra, broadcast through WEAF. Also, through WEAF, the series of New York programs being given by George Barrère and his Little Symphony Orchestra. Mr. Barrère, it is scarcely necessary to explain, has been for more than twenty years first flutist in the New York Symphony Orchestra, coming to this country from Europe to join that organization. He is not only the most famous flutist in America but also has no superior in Europe. For some years he has been at the head of the Little Symphony, which he organized and which confines itself mainly to playing works not suitable for a large orchestra. The broadcasting of his series of New York concerts this season is doing much to lift radio music from its deadly monotony.

Then there are the programs of the American Orchestral Society heard through WJZ and WJY. This


SIGNOR GUERRERO AND FERDINAND FILLION

Recently heard in joint recital from station WGY. Signor Guerrero is a South American pianist, now of the staff of the Toronto Conservatory of Music. Ferdinand Fillion, concert violinist, is also on the staff of the Toronto school

orchestra, of more than one hundred members, is maintained chiefly for the purpose of giving young American musicians of recognized ability opportunity to keep in orchestral training so as to be ready for positions in the permanent symphony orchestras of the country when vacancies occur. Although American compositions are featured in the programs, an extended variety of the standard orchestral masterpieces are also played. In all, eighteen concerts will be broadcast, thirteen for adults, under the direction of Chalmers Clifton, and five for children, under the direction of Ernest Schelling. The remaining dates for the programs for adults are January 18 and 22, February 15, 19 and 28, March 22, 26, 30, and April 19 and 23. The dates for the children's concerts have not, at this writing, been announced, but they will be given at Aeolian Hall, New York, Saturday mornings during February and March, probably in alternate weeks. Thanks to the farseeing judgment of Franklin Robinson, executive secretary of the American Orchestral Society, the broadcasting of these programs has been made possible.

Also, there is the Eastman School of Music at Rochester, New York, that is making possible, through station WHAM, the hearing of much good music by owners of radio sets. The concerts of the Rochester Symphony Orchestra, operated in connection with the Eastman school, are being broadcast through station WHAM. The schedule of dates for the remainder of these programs is: January 22, February 19 and March 19, in the evening at 8:30, eastern standard time; and the afternoons of February 26, March 5, and March 9.

This Eastman School of Music is likewise presenting chamber music concerts which are also being broadcast by WHAM. There still remain in this series the evening programs of January 20 and 30, February 27, March 9, and March 27.

The directors of WHAM have stated that these two series of concerts are broadcast this winter because last season when the experiment was tried of putting a few of the programs from each series on the air they proved by far the most popular feature the station had ever broadcast. Which is but another proof that the public, given a chance to hear or see the best in art, will quickly appreciate it.

Some Suggestions on Studio Etiquette and Management

SOME time ago we took pleasure in quoting in this department some comments on broadcasting received from Mr. Richard K. Morton, of South Boston, Massachusetts, who has himself been heard from various radio stations in the East. Now comes to hand another letter which so well

covers some of the questions that are continually being asked the conductor of this department, by people near and far, that Mr. Morton is again quoted.

> Many listeners-in wonder why so little consideration is given to balancing radio programs. If there is an important psychology in the arrangement of concert recitals, articles in magazines, etc., there is a psychology in radio programs. . . . What can a radio lecturer do, if he follows the broadcast of a prize fight? Why, moreover, is there so little regard either for the psychology of the radio artist or the listener-in? . . . Take, for example, the tired listener-in who is furnished late at night with a lecture immediately following jazz!
>
> While broadcasting from one studio, this was the situation which confronted me: the announcer had, at the last moment, scribbled data relative to my name, the title of my talk, etc. He was vigorously puffing a cigarette in the well-padded and almost hermetically sealed studio. The air was hot, stagnant, stale. I had to stand and talk into a microphone which was only as high as my waist; the alternative was to sit in a cramped position at a small table. Fully twenty-five artists and visitors were in the studio. They made distinctly audible and belittling remarks relative to me and to my contribution.
>
> Am I a hypocritical grouch when I ask if listeners-in want this type of situation to be endured by radio artists?

Kossuth, Wheeling

GEORGE BARRÈRE

Flutist of international renown and conductor of the Barrère Little Symphony Orchestra whose New York concerts this season are being broadcast by station WEAF

Numerous inquiries have come to the editor of this department, all couched in about the same form. "Do broadcast directors allow people in the studio while any one is broadcasting? I'm sure I can often hear other voices from the studio in addition to the one that is giving the number."

And many artists have said with emphasis after a first broadcasting experience, "Never again! There was a mob in the studio, and another mob running in and out. Imagine trying to give a decent performance on a concert stage under such circumstances."

Note what Mr. Morton has to say:

> It is beyond me to understand why so many stations still persist in allowing a full studio while a number is being broadcast. It is also beyond me to understand why they allow going into and leaving the studio during a number. Personally, I feel that it is wrong for an artist to bring to the studio, for obvious reasons, a host of his admirers.
>
> As for the question of requesting cards from the radio audience, I think it is very poor taste for a speaker to request cards relative to his own speech. Even announcers should make such requests with moderation. . . . And why do listeners-in, when sending in cards relative to broadcasts, confine themselves to flattering but meaningless generalities? Why not give the artist genuine criticism, showing an intelligent interest in his contribution? Why not be specific, discussing the item in a concrete, analytical style, which will stimulate the artist, give him suggestions, and call his attention to points of value to him?

The cards that are sent to radio stations are a good deal like the telegrams and telephone calls sent in during a program, than which nothing could be more tiresome or stupid. Fortunately, broadcast directors do not attempt to read to their listeners-in the communications they receive by mail. If they did—but perish the tho't!

Radio Vision Both Ways

SCARCELY a week passes without a story being published regarding the future of radio vision, if it may be called that. We are constantly being told that, ere long, we shall all be able to see as well as hear the radio speaker or musicians. We shall even be able to follow the games that, point by

point, are now broadcast, or to see the opera to which we listen at the receiving set, or the orchestra.

Will this predicted marvel work both ways? Will the broadcast directors be able to watch their listeners-in? It is to be hoped so. For the quickest and surest way to bring about the much needed reform in radio programs is for the broadcast directors to see how their programs are being received. Some of them would experience a tremendous shock.

Why They Say "Please Stand By"

HAVE you ever wondered why the broadcast announcer, when there is a wait between numbers, always tells you to "Please stand by"?

Why, "stand by"? That ancient bos'on's warning?

Mr. Rhodehamel, of station KGO, at Oakland, California, explains that this term and various others used by broadcast announcers, came into use in radio stations because nearly all broadcasting operators have been to sea as ship operators. He states that, at KGO, the operators alway refer to the floor as the "deck." Walls are spoken of as "bulkheads." Windows are called "ports." Operators do not work so many hours, they "stand watch." The book recording transmission and changes of apparatus is called "the log." The clock isn't a clock, but a chronometer, all rigged up in gimbals to take care of the swaying of the ship, in the regular little brown mahogany case.

Not all broadcasting stations are as nautical as this, but from every one of them you will hear the old call of the sea, "Stand by!"

There is a Demand for Education by Radio

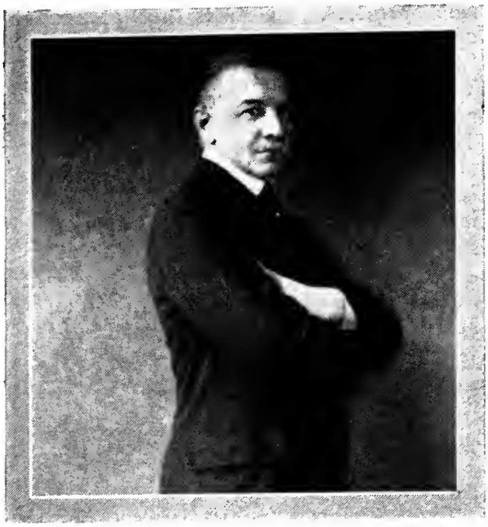
THE lectures on music appreciation given Friday evenings at 7:30, through station WBZ, by Professor Stuart Mason of the New England Conservatory of Music, have been a pleasing diversion to some listeners-in and, no doubt, a source of much desired instruction to many more.

But, as these lectures, which are illustrated at

Thomas Coke Knight, New York

BERNHARD LEVITOW

And his Hotel Commodore Orchestra scheduled for 200 radio concerts from WJZ and WJY this season. They play much beautiful music and play it remarkably well



Whiting, St. Louis

RUDOLPH GANZ

Conductor of the St. Louis Symphony Orchestra whose Saturday evening concerts are being broadcast from station KSD. Mr. Ganz, in addition to his orchestral work, has long been among the world's noted concert pianists

the piano by Professor Mason, occupy but one half hour, he must feel, as do some of us who have studied the subject matter of the lectures during our years of musical training, that the time allotted him is so short he can scarcely touch his subject before it is time for him to stop. That he can get over as much ground each week as he has so far succeeded in doing shows well that he is thorough master of his subject. But, even so, such courses in music appreciation confined to one half hour a week cannot be other than superficial.

When radio has settled down to a constructive basis, instead of being, as now, chiefly a medium for light entertainment, these educational courses will take on a more important aspect. No doubt, broadcast directors would hesitate to put on a musical lecture that lasted an hour. They would see, in their imagination, thousands of impatient listeners tuning out to a more congenial attraction. Yet, they might also use their imaginations to realize that those who interest themselves in these educational courses would be more numerous if they thought that the paying of the fee of one dollar, for literature and examination papers, would include an hour's instruction weekly.

Perhaps, in time, we shall have certain broadcasting stations given over wholly to educational programs. If this day comes—and is not such a thing plausible?—a course in musical appreciation, in literature, or any of the other educational subjects now put on the air, will be more thorough than is at present possible.

A Good Entertainer of Children

THE oh, so sweet, dearie-dovey children's entertainer is the most aggravating thing that comes over the radio. But when such an entertainer is good, that is to say, when he or she talks to children as if they knew something, then this program feature is a delight.

Such an entertainer is "Uncle Walt," of the Chicago *Tribune* station, WGN. He is an unfailing joy. He talks to the children as if they were his equals, and so they are. Who was it said that the only people for whom you have to write in words of one syllable are grown-ups? For children, never! Uncle Walt understands this. Have you ever heard him reading *Alice in Wonderland* to the children? And have you ever heard him sending up stars for them? If you haven't heard him sending up the stars you have missed one of the most beautiful features ever broadcast.

It really seems as if it is up to us listeners-in to devise some way of sending up a big star for Uncle Walt. Yet, upon second thought, that would be much like carrying coals to Newcastle. For Uncle Walt is himself a bright and shining star in the broadcasting world.

Musical Laughter

HERE is a semi-musical joke that came from station WEAF. If memory serves rightly it was told by one of the "Happiness Boys," excellent fellows that they are.

"Did you hear about George going home just a little lit-up the other night? No? Well I'll tell you about it.

"His wife, she was awful mad when she saw him, and she says:

"'What's the matter with you?'

"'Syn—syn—co—pa—shun,' says George.

"'What?'

"'Syn—syn—co—pa—shun.

"'And what's that?'

"'It's syn—syn—co—pa—shun.'

"Well, his wife didn't say anything more that night. But when George came home the next night she says:

"'Huh! I knew I was right last night about what was the matter with you. I looked that

syncopation up, and it said it means, uneven rhythm from bar to bar!'"

That's a relief from jazz, anyway.

NEVER, even though the whole world adopt it, will this department ever refer to broadcasting as "radiocasting." Of all the unimaginative, hard-sounding, machine-like words invented, "radiocasting" is the most disagreeable. When it comes over the air, "This is radiocasting station XYZ"—*à bas !*

IF DELILAH had jazzed "My Heart at Thy Sweet Voice," when she was putting over the treachery "stunt" on Samson, he never would have been shorn of his strength by losing his locks. For he never would have fallen for jazzful love-making.

SOME women's voices of beautiful quality have been heard over the radio lately, but almost without exception the slow tempo at which the songs were sung completely ruined them. There was the contralto who sang not long ago from WBZ's Boston station "When the Roses Bloom Again" and "Drink to Me Only With Thine Eyes." We heard a lovely voice, but it was quite impossible to listen to it because of the dragging interpretation.

FROM a WGY program:

Waltz, "Take a Look at Molly" . Franklin

Research Talk, "The Metallography of Paint" (Courtesy Engineering Foundation)

Fox Trot "Jealous" . . . . . . Malie-Finch

Does any one except the compiler of this program know why a talk is put in such a place? Does even the program compiler himself know?

IF THOSE responsible for the mid-week services under the auspices of the Greater New York Federation of Churches, broadcast from WEAF, expect to further the cause of religion through radio, they will have to "pep up" some of the performances. We tuned in on such a whining performance of "Abide with Me" the other night, that we abided only long enough to tune-out. For consolation we listened for quite some time to the Night Hawks.

CHICAGO is one of the greatest music centers in the world, and in this country is ranked by all as equal to New York (and by some as that city's superior), as a place where the best music may be heard under the best advantages.

How, then, does it happen, that the music programs broadcast from Chicago are, with rare exception, not equal in quality to programs heard from some other cities of but slight musical reputation? Certainly, one of the Chicago stations can bring us something good.

Thomas Coke Knight, New York

MRS. CLARA E. BREAKEY

Lecturer on home economics at New York University, who gave a course on coöperative economics from station WJZ with such success that she seems to have nullified the contention that women are never as effective speakers over the radio as are men

Some Experiences With the Blind and Radio

By CHARLES T. WHITEFIELD

WE FANS have got the impression, no doubt, that everybody in the United States knows about radio—at least, knows a little—but I have recently had some experiences which have caused me much surprise.

I live in a county which contains about 125,000 people, and in a moment of bravado I offered to provide all the blind people in the county with a suitable radio receiver, so that they might listen in to the concerts in New York and get the benefit of all the good things that were going on within a few hundred miles of the metropolis.

In such a large county I expected that there would be a hundred blind persons. Much to my surprise, after making every effort to find every blind or near blind individual, I discovered that there were only about twenty. Each one of these people I visited, and had some tragic experiences.

For instance, approaching a broken-down old house, with debris of all kinds spread in every direction from the front door, the old man who opened the door kept his foot carefully in possession of the opening so that I could not break in. When I told him that I wanted to give his son—a grown man of thirty or forty who has been blind for twenty years—a radio, he was very wroth. After some conversation he said that if I brought the radio machine, he would take it out in the backyard and chop it to pieces.

Here the conversation would naturally seem to end; but I asked him if I could not see his son, who still at eleven o'clock in the morning was lying in bed with nothing to do except to think of his own misery. The son took a more cheerful point of view, and said that he had been told about the radio, but had never actually listened to one. After some persuasion I got the old man to agree that if I would send a machine, with a Boy Scout to put it up, he would allow it to be introduced; but he reiterated a dozen times that he wouldn't pay a cent, and I had the greatest difficulty in convincing him that I was not looking for money.

Some of the other cases were not quite so successful as this. For instance, I visited an old man who had caned chairs and done other things, but in his weakness had had to give up even this occupation. He was taken care of by two or three sisters who lived in the house with him, and I thought it was an ideal place for a receiver. After broaching the matter with as much delicacy as I knew how, he made a violent speech to the effect that he had already heard the radio once, and he never wanted to hear it again. I still urged that perhaps this radio was better than the one he had heard and that his sisters might enjoy it with him; but he ended up by stamping his feet and saying that he was prejudiced against the radio and would not have one. I hope to live long enough to go back with a portable set and make a convert of him, but the incident is closed for the present.

Is It Not True

That most of our happiness comes from making others happy? Here's a chance for you to do a great deal of real good for the blind in your neighborhood. The accompanying article describes how the blind in a certain county were made more happy by the gift of a radio set. The gift was made complete, with batteries, head phones, and loud speaker, and the local Boy Scouts agreed to install and inspect the sets monthly. There is much that radio can do for those unable to get out in the work-a-day world, and it is good to know that concerted effort is being made to see that the wounded veterans have receivers. This latter is being handled by the *Sun*-Roxy Fund in New York. Another fund now being raised nationally by the American Radio Association, 50 Union Square, New York, is to buy radio sets for every blind person. The Association will undoubtedly welcome independent aid of the sort outlined here.—THE EDITOR.

Some of my visits were quite inspiring. For instance, one man who had been blind for about seven years was extraordinarily cheerful, and he told me that until he adjusted himself to his new life he was very, very unhappy. Finally he convinced himself that a man could live and take an active part in life though blind; and when he had done this he became happy, and has been happy ever since. He had accomplished the extraordinary feat of building himself a house, mostly with his own hands and the help of his wife. He was an enthusiastic radio fan, but had to go a mile and a quarter to the house of a friend when he wanted to listen in, and this was difficult because he had to have some one take him. Naturally, the idea of having a machine for himself was a source of great joy to him.

Three or four blind people I found had a radio, and all of them were receiving the greatest benefit and enjoying it hugely.

HOW THE SETS WERE INSTALLED

AFTER rounding up all the people whom I could find, I enlisted the help of the Boy Scouts to put up the machines and take care of them. We selected a very simple type of machine, some with a pair of head phones, and some with loud speakers. The cost of the machine, batteries, and tubes was about forty dollars apiece. The Boy Scouts put them up, of course without charge, and are expected to make a monthly inspection of each blind person's radio and report the conditions.

Although there were some blind people who were unwilling to have anything to do with this new-fangled machine, in almost every case I persuaded them that they would get pleasure. The humorous side has been their fear that it would cost them money. Without exception, they showed the greatest apprehension lest they would be led into something which would bring them financial responsibility. When I told them that I was doing this for pleasure, they did not accept it with any degree of cordiality, feeling that there was something behind which they did not understand; in fact, that something was being put over on them.

The experience of visiting these people, which I apprehended would be an unpleasant job, was quite the reverse. Enough people were very grateful to make the whole enterprise worth while, and I feel sure that the success of the thing is beyond peradventure.

Among the readers of RADIO BROADCAST there must be thousands who could do this in their local town or county. My own experience has proved that it has to be done personally and cannot well be done by somebody hired for the job. I cordially recommend the idea to anybody who wants to add comforts and pleasure to the lives of blind people. If a sufficient number of people could be got together to cover the country, the load of pain and suffering would be tremendously decreased.

For the practical reader I may say that the machine we have found best adapted to the purpose is of the reflex type.

"AS THE BROADCASTER SEES IT"

IS THE title of an interesting series of articles by Carl Dreher, the first of which will be a feature of this magazine for March. What the broadcaster is doing, how he does it, and what he is thinking of while he is doing it, will form the subject matter of this series which should interest those both active and passive in radio. "As the Broadcaster Sees It," will give the broadcasters—engineers and program directors—a place where they may exchange ideas. Listeners will be able to "look at" broadcasting from the inside. Mr. Dreher is chief engineer of one of the best known American broadcasting stations. These articles will not supplant but complement "The Listeners' Point of View."

CHECKING RECEIVERS FOR THE INTERNATIONAL BROADCAST TEST

A corner in the RADIO BROADCAST Laboratory which shows some of the apparatus employed in the tests. At the left is a low powered radio telephone transmitter, presented by the Radio Corporation, next to it is a Roberts short wave receiver, and beyond that, a Kennedy long wave set is being operated by John B. Brennan, editor of the Grid. Signals from all the European countries participating in the tests were logged at the laboratory through which the broadcast activities of two continents filtered during the test week

THE MARCH OF RADIO

By J. H. Morecroft

Past President, Institute of Radio Engineers

The Great Success of the International Tests

WE CAN record a well-merited success for those who conceived and executed the international radio broadcast tests of 1924. It is only a short time ago that Mr. Paul F. Godley, one of the most skilled radio operators in America, first attempted to hear a low-powered, short-wave set span the Atlantic. It was really a wild idea at that time, and one for which a successful outcome had been predicted by practically no one.

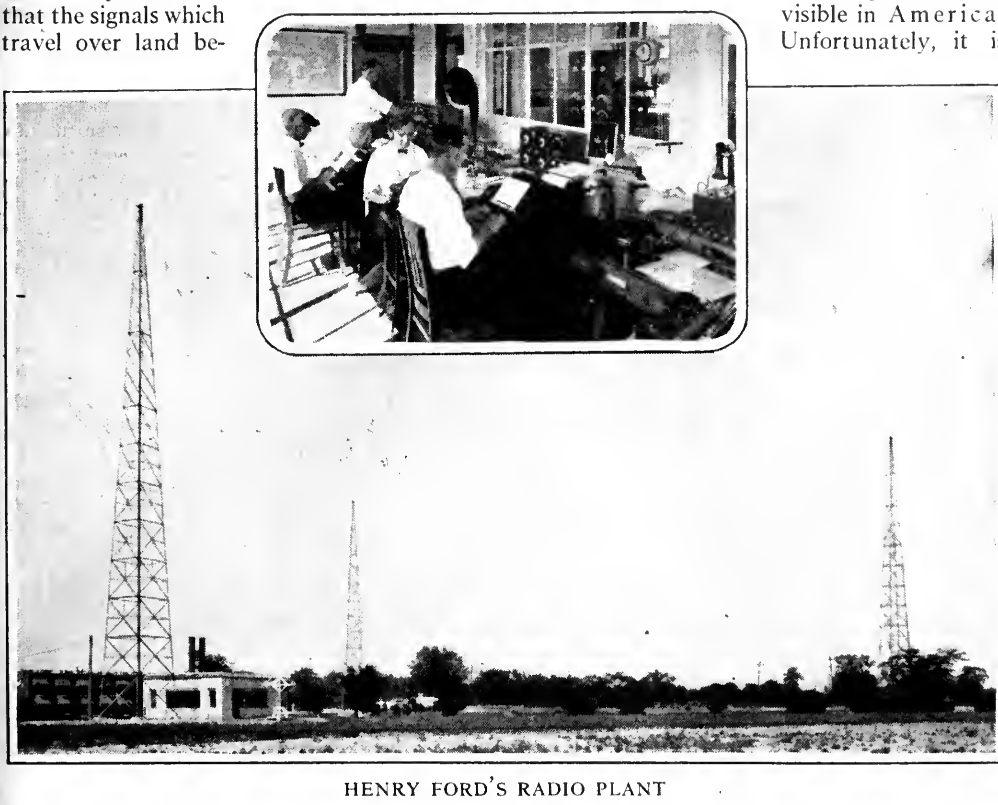
He used a many-tubed super-heterodyne working on a specially constructed antenna, and was finally successful in picking up code signals from several American amateurs. Mr. Godley's receiving apparatus was set up in Scotland.

During the test just come to a close, thousands of American radio fans heard many of the low-powered, short-wave European stations. When one compares Godley's test with those of 1924 one cannot but believe that radio

communication is striding forward rapidly. The successful listeners during the test were not skilled amateurs. They had sets using a half or a third as many tubes as did Godley's, they had ordinary short antennas, and in some cases loops only, and they received radiophone signals, whereas Godley received dot and dash telegraph signals. This latter fact is of much more importance than one might think; the same amount of power used for telegraphing as used for telephoning is good for possibly twice the distance of communication.

It is not easy to conceive of just what these long-distance tests mean from the standpoint of power. A station rated as 500 watts probably radiates about 100 watts of power, and the energy thus thrown off spreads out in all directions. Much of it is radiated up 50 or 100 miles and there is partly dissipated in the semi-conducting atmosphere and partly reflected down again to the earth. Part of the energy is absorbed by buildings, and even by vegetation on the earth's surface, which is evidenced by the fact that the signals which travel over land between two stations are by actual measurement only about one third as strong in summer as in winter.

In spite of this dispersion, absorption, and reflection, there is still left sufficient power after a voyage of 4,000 miles to give an intelligible signal to the radio listener. Imagine a 500 watt incandescent lamp burning in France, Italy, or England, being visible to thousands of observers in our country! Imagine communication being carried on between those countries and ours by a blinker code worked on the lamp. In trying to imagine such a feat remember that our best lighthouses, having lamps of 100,000 candle power or greater, are visible at most over perhaps 50 miles. One feat which has been accomplished in radio is still aiting to be solved in the realm of optics, that is, the magnification of the received signal. If we had some apparatus through which to look, which would do the same thing to the light waves as our amplifiers do to the radio signal, then possibly the 500 watt lamp in Europe would be visible in America. Unfortunately, it is



HENRY FORD'S RADIO PLANT

At Dearborn, Michigan. The three towers of the 1000 watt station WAV which operates on 1713 meters with Ford stations at Springfield and Jackson, Ohio. The four lake carriers of the new Ford Fleet are in constant communication by radio with the home office, wherever they may be on the Great Lakes, which can be a maximum of five hundred miles distant. More than 400 messages a day are handled by the operators, shown in the insert

not possible to amplify light as yet. Radio has been able to march right away from the older branches of science in this respect.

Besides giving a thrill to the broadcast listeners who heard the transatlantic stations, these tests, planned and executed by RADIO BROADCAST, have a real educational value. Few listeners to-day really appreciate the true status of radio transmission. If a signal will go 1,000 miles, why not 2,000? No reason at all, and it actually does go 2,000 miles, or 10,000 miles for that matter. Every day the signals from all the European stations are racing past our receiving sets. Just because we don't hear them is no evidence that they are not there. The signals are there, but so are all the other electrical noises set up by electrical disturbances of all kinds, artificial as well as natural. Every time a trolley wheel jumps off the wire in Chicago a radio signal is sent to New York and beyond, and every elevator which starts or stops in New York reciprocates for the benefit of Chicago listeners. Every electrical storm in the Gulf of Mexico splashes radio signals of all conceivable frequencies over the whole world, and the little regenerative receivers in Baraboo and Chappaqua add their share to the Babylonian chatter resulting in what we call interference, static, or plain "noise."

And here we add the telephone engineers' motto on transmission, a motto which is of as much significance to the listeners as to the engineer. "Don't let your signal get lower than the noise or you'll never find it again." Now the reason we do get European stations during these tests and not at other times is because ordinarily the noise level is higher than the signal and there is no set yet made which can reach down into this mess of noise and extract the signal we are looking for. So we know now that the way to hear Europe is to lower the noise level (at least insofar as it is due to artificial causes) and hope the natural noise is not too loud. Another way is at once evident to us, that is, to raise the signal strength by putting more power into the sending station—this is probably the real answer to transoceanic radio phone transmission. Raise the signal level a hundredfold, then the amount of noise we ordinarily have to-day will not be able to submerge it.

Government Monopoly of Radio Is Wrong

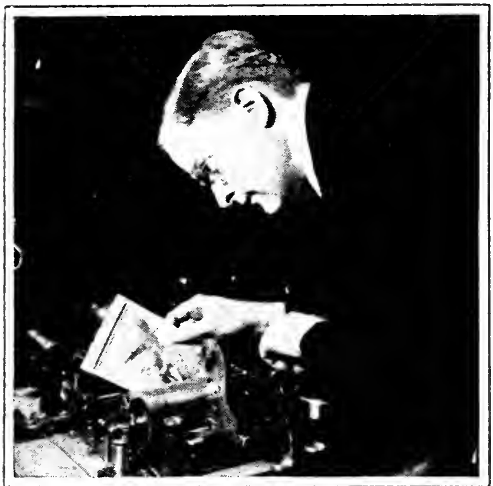
IN A recent talk before a meeting of representative business men, Professor Pupin, known to scientists because of his contributions to alternating current theory and practice, and to the general public because of his autobiography *From Immigrant to Inventor*, expressed his views on governmental control of technical developments and industries. In view of a recent cable dispatch from France indicating a tendency in that country to control radio by strict governmental supervision, Professor Pupin's views seem especially timely. Besides being a scientist of a high order, he is known by his friends to be of sound business sense, having reasonable and well-founded views on the important questions daily confronting our country.

The weakest point in democracy has always been the lack of appreciation of expert knowledge. Railroads, telegraphy, telephony and radio-broadcasting, electrical lighting and the electrical transmission of power are certainly public utilities, but the intelligent people of the United States will never consent that these things, requiring an enormous amount of expert knowledge, be placed under government ownership. The machinery of our government or of any other form of government known to man to-day is utterly incapable of handling technical problems, which require the highest type of training applied to the highest type of intelligence.

All of these public utilities are full of complex technical problems which cannot, and never were intended to be, handled by any government. In Europe we see that where there is governmental ownership, the utilities are being run at heavy deficits. And only recently Mussolini has said that he wants to get away from government ownership and adopt the American system.

In the light of this opinion, it is apparently an unwise step which is being fathered by Pierre Robert, Under Secretary of State for Posts, Telegraph, and Telephone. He recently announced in the Chamber of Deputies that he believes that radio broadcasting should be organized as a government monopoly. He proposes to submit a bill to the Chamber at its present session and will urge its adoption. It seems strange that Professor Pupin, who knows his Europe much better than most of us, used it as a striking example of the futility of expecting public utilities to be operated successfully under governmental control.

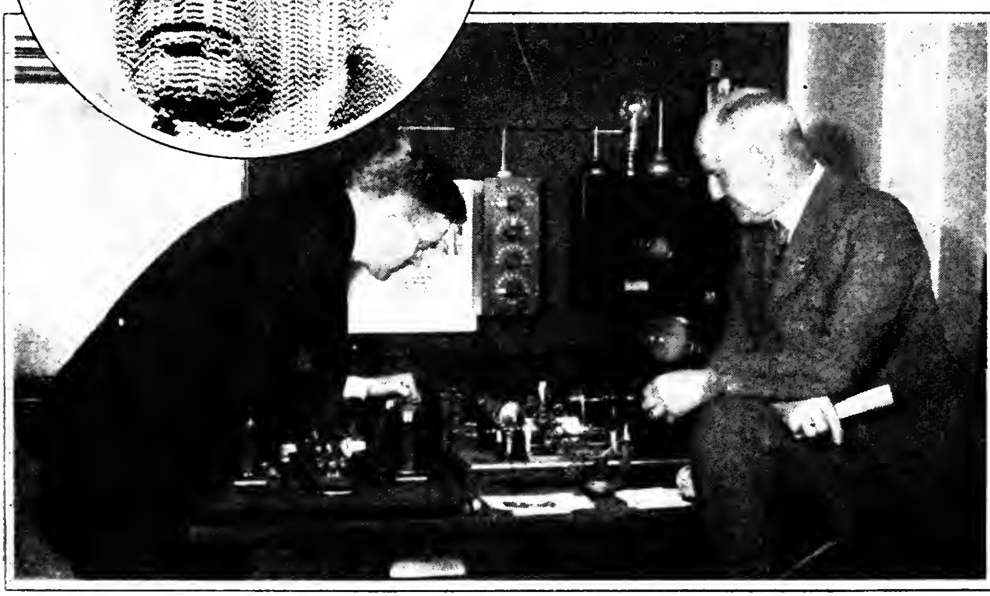
We learn also that the Minister of the Interior has organized a special "listening-in" service to be operated by police headquarters to insure that radio broadcasting shall not disseminate information detrimental to what he considers the "country's good." Propaganda of all kinds will be taboo, and we learn that the police will try to prevent the "transmission throughout the provinces of information on daily market conditions and prices, as essen-



tial products would thus be held up by the producers for the most favorable terms, thus increasing the cost of living." Here in the United States the farmer is continually urged to utilize the radio dispatches of the Department of Agriculture and other government bodies which send out market conditions specifically to enable him to market his products most profitably. It is difficult to understand the French attitude. Isn't the farmer entitled to whatever help radio can give him? Certainly no government official in the United States would boldly declare, as did the French minister, that he didn't mean to help the farmer market his wares as profitably as possible. It seems that there must be no "farmer vote" to worry about in France as there is in America, as most of our politicians seem to think.

Photographs Across the Sea

ONLY a short time ago we commented on the excellent transmission of pictures from Chicago to New York over the wires of the American Telephone and Telegraph Company and also on the successful attempt to send them from Washington to Baltimore by a radio channel. About the same time that occurred here, in France M.



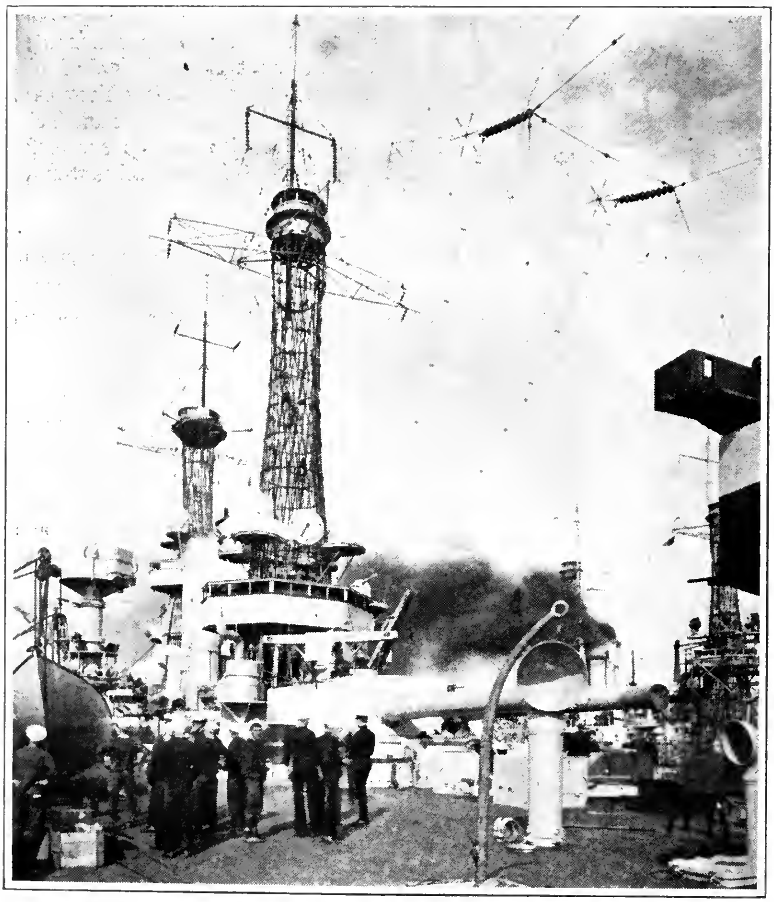
FACES ACROSS THE SEA

Became a reality when engineers of the Radio Corporation of America and the British Marconi Company succeeded in transmitting photographs by radio from London to New York. The system was developed by Capt. R. H. Ranger of the Radio Corporation. The top photograph shows Capt. Ranger, the round insert is a photograph of Ambassador Kellogg, one of the first to be transmitted across the Atlantic. The bottom view shows General Harbord, president of the Radio Corporation (right) and Capt. Ranger

Bélin announced the successful conclusion of his efforts to transmit pictures by radio. Now we have pictures across the Atlantic. The Radio Corporation of America has succeeded in sending some quite recognizable portraits from Carnarvon, Wales, to Riverhead, Long Island. High power is used so that the signal received in America is reasonably large compared with static disturbances, and in this way the blotchy appearance which is sometimes caused by atmospheric disturbances has been practically eliminated.

The general scheme used is the same as before: light from (or through) the portrait to be transmitted falls on a sensitive photoelectric cell. The action of this cell controls the intensity of the signal sent from the transmitting antenna. The light beam used is very small (only about one hundredth of an inch square) so that it covers only a very small part of the portrait at one time. By moving the picture past the light beam back and forth and having quite similar receiving apparatus actuated from the received signal, a picture is formed by packing together a series of shaded lines. It takes about three seconds to draw one line completely across the picture, and as there are about 100 lines per inch it may be figured out that to transmit a picture about three inches square requires twent minutes.

Fixing the charge for picture service by the amount a station could earn in a similar time by transmitting telegraph signals, each picture would cost about $50. Most of us will evidently send our pictures by mail for quite some time to come, but newspapers may well use this picture service. The same apparatus can be used for sending the written or printed word, and it may turn out that, with the improvements which are sure to come, one can send a message faster by this photographic scheme than it is by the present dot and dash code.



THE U.S.S. "TEXAS"

Showing the elaborate radio antenna system, which is used to dispatch the very considerable radio traffic necessary on practically every naval vessel

It is not quite clear from the announcement made by the Company just what its engineers have contributed to this photograph transmission development. Practically the same process as that outlined has been used before for picture transmission, but it is quite possible that valuable additions to the progress of the art have been made in synchronizing the sending and receiving apparatus, and in eliminating the blotches caused by atmospheric disturbances. After the transmission has once started, it is essential in any

PROMINENT FIGURES IN THE RADIO WORLD

In the group, from left to right are, Prof. Alfred N. Goldsmith, past president, Institute of Radio Engineers, and chief broadcast engineer, Radio Corporation of America, John V. L. Hogan, consulting radio engineer, Prof. J. H. Morecroft of Columbia University, another past president of the Institute of Radio Engineers, Philip Torchio, L. W. Chubb, and Prof. L. A. Hazeltine, Stevens Institute of Technology to whom the patent on the neutrodyne receiver was granted

of these schemes that the sending and receiving drums run in exact synchronism, and to do this when 3,000 miles of ocean separate the two, is quite evidently a real task. Undoubtedly we shall later get a better explanation of the new features of the Radio Corporation's scheme, which shall show how the requisite synchronism of sender and receiver is maintained in the radio channel.

The Radio Compass Can Guide Aëroplanes

A REPORT from Washington, evidently emanating from the Army Air Service, tells of "the first practical test" of the radio compass as an aëroplane guide. We were under the impression that the radio compass was quite successfully used during the War to guide aëroplanes, but now it appears that some new developments make the Signal Corps rise and assert that a real advance has been made. Two special radio compass stations have been established, one at Dayton, Ohio, and the other at Moundsville, West Virginia. By means of the signal sent out from these stations, Lieutenant G. W. Goddard was able to "keep in a bee-line," as he says, between the two fields even though the day was so foggy that he could not get his bearings from well-known landmarks.

The transmission system was such that when he was on a straight course he heard only dashes in signalling, but when he got off the course the signal was changed. If his plane was veering to the left he heard a dash and dot repeated at ten-second intervals, but if he was going to the right of the proper course he heard a dot and a dash repeated at the same interval. By thus correcting the direction of his flight until he heard dashes only he knew that he was directly in line with the station toward which he was trying to fly.

One who has not been up in an aëroplane cannot appreciate the difficulty of getting radio signals in the cockpit. Many times we

ask some one in the house to keep quiet when we are trying to pick up a distant station. Even a low-pitched voice in the same room gives quite appreciable interference. How is it when the air is rushing by the listener at the rate of 100 miles an hour and the guy wires all singing notes of their own and the 150 horse-power motor exhausting right at his side with no muffler at all? The combination of noises is as bad as that in a boiler shop, if not worse.

To overcome this excessive disturbance, the radio listener must wear a padded helmet, in the sides of which are fitted the ear-phones. It is remarkable how much noise half an inch thickness of leather and felt can shut out. The rushing air becomes quiet and even the roar of the engine exhaust becomes a low hum. Of course even with the best helmet obtainable one needs a pretty strong signal for reasonable audibility, considerably stronger than is required by the ordinary listener. To assist the helmet in eliminating engine noises, long exhaust pipes were fitted to the engine of the test plane, so that the exhaust actually took place behind the cockpit, whereas general'y it is right beside the pilot.

The antenna used was a long trailing wire hanging through the bottom of the cockpit and held reasonably vertical by a heavy lead weight. The general scheme used during the War was to have a loop antenna on the plane and get compass bearings as a ship does to-day.

After landing at the end of his successful flight Lieutenant Goddard said that it "had not been necessary to keep an eye open for landmarks at all." The radio signals enabled him to find his way directly to the station which was his destination.

In the same line of radio's progress we read with interest the report of George R. Putnam, Commissioner of Lighthouses of the United States. His department, we learn, now has twelve radio fog signal stations scattered along the coast and is establishing new stations as fast as funds permit. Commissioner Putnam says that this country leads the world in this form of relief. We were the first to give fog signals successfully and now have more of such stations than all of Europe put together.

Too Many Went to Fights by Radio

IN GENERAL, radio is praised for the success with which it disseminates news and entertainment, weather reports for the navigator, market conditions for the farmer, music for the dance party, and football narratives for the college alumni or sports devotees. Football games, especially, have been well broadcast. An announcer like Graham McNamee performs his task so well that we can quite clearly visualize the mud-covered combatants as they slosh around through the mire of their battlefields. Judging by the newspaper reports of the attendance at these games, which at times have been as many as 100,000 for a single contest, one may safely come to the conclusion that football broadcasting has not seriously interfered with the gate receipts.

Another line of sport has apparently not fared so well as a result of radio's publicity. Tex Rickard, who makes a very good living by matching prize-fighters, has just put radio on his own Index. For the past three years bouts have been fought before the microphone so that the cheers and jeers, the gong, and even the thud of blows could be heard by the radio listener. And so vividly has radio portrayed the fight that many have preferred to stay at home, where there was no admission to pay, and no crowd of a hundred thousand through which to mill. So Mr. Rickard has decided that hereafter radio and he shall part company; the fight fan who wants to see two human beings who consent to batter each other for about $1000 a punch will have to go to the scene and contribute his share of the gate receipts.

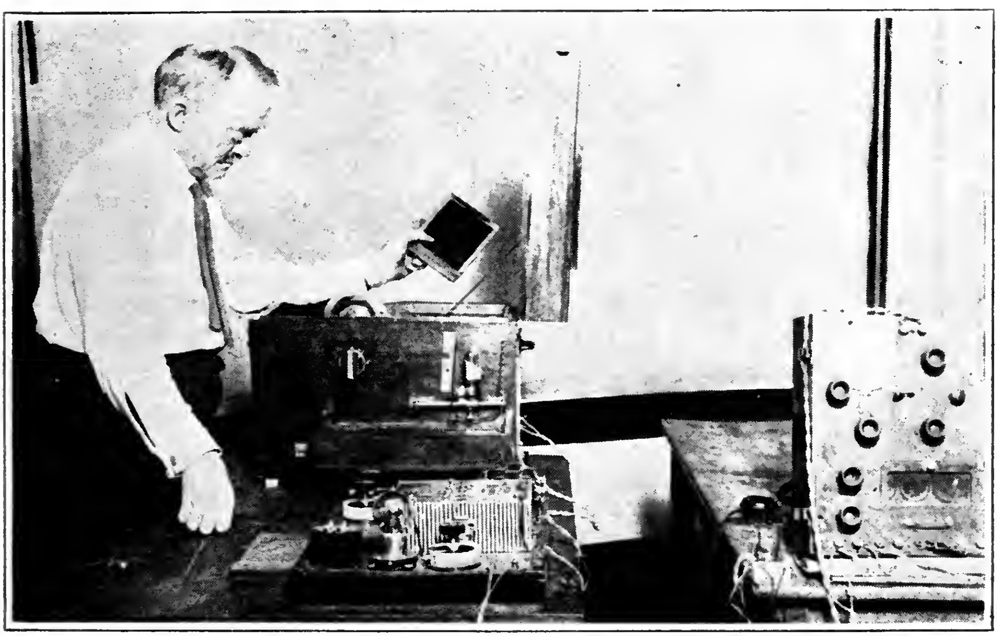
How Electrons Are Heard

IT IS only a few years ago that scientists dared to venture the idea of the electron, for before that the idea of the molecule and then its small comrade, the atom, had certainly stretched imagination to its apparent limit. For example, in a piece of cubical copper about one half inch on an edge, there are one million million million million atoms. To make a row of copper atoms one inch long, about two hundred million of them would be required. Imagine then the intrepidity of the scientific worker who dared to announce the existence of particles much smaller than the atom, so small that it takes one hundred thousand of them to make a mass equal to that of one copper atom. Gifted with a powerful imagination must be the worker who deals with electron phenomena, and especially is this true of the research worker who is going to find out new facts about the behavior of these infinitesimal particles of electricity.

It might be thought that particles as small as the electron could be dealt with only in the imagination, that measurements as to their size, velocity, quantity of electricity, etc., could not possibly be made. Yet this is far from the truth. The mass of the electron, and its size and electric charge, are known as accurately as is the length of a yard stick. Measurements of the electron carried out by independent methods agree with each other to better than 1 per cent.

Professor Millikan, when at the University of Chicago, carried out some remarkable experiments on electron measurements. So important were his results regarded in the scientific world that he was given the Nobel Prize. Millikan sprayed oil into very small drops, so small that they were nearly stationary in the air, even though free to fall. Some of the drops he used fell only one quarter of an inch in ten seconds, so little did the force of gravity attract them. A very powerful microscope was required to see them; in fact, the drops were never seen as such but appeared like the dancing circles which appear if one presses his eye-ball too severely. By having these drops of oil between electrically charged plates it was possible to make them stop falling or even move upwards if the droplet happened to be charged electrically. Now if electrons were produced in the space where the oil drops were being observed, one would occasionally attract itself to an oil drop, which would then immediately change its motion. By observing the change in motion and knowing the size of the drop (by other experiments) the charge of a single electron could be computed. Occasionally an oil drop suddenly changed its motion twice as much as did the others. This meant to the observer that two electrons had simultaneously attached themselves to the oil drop.

So by these remarkable experiments of Millikan's the electron was almost observed in motion. Now the electron is being heard! Dr. Albert W. Hull, one of the best-known research workers of the General Electric Company, announces that by apparatus which he has perfected it is possible actually to hear the electrons which fly across a vacuum tube. When they strike the plate of the tube they set up oscillations which, if sufficiently amplified, can be heard. Of course the amplification required is enormous, so great that if it were tried with the ordinary unshielded amplifier outfit, the noise due to atmospheric electricity would swamp the noise due to electron bombardment. By working inside a metal cage,



C. FRANCIS JENKINS

A radio investigator of Washington who recently was successful in transmitting photographs by radio from Anacostia, Maryland to Medford Hillside, Massachusetts on a wavelength of 746 meters. The photograph shows a laboratory set up of some of the inventor's apparatus at Washington

however, the listener is reasonably well shielded from extraneous electrical disturbances, and it is with such an arrangement that Doctor Hull and his co-worker, Prof. W. H. Williams, announced that they now hear the bombardment of the plate which is set up by the billions of electrons which every second pass from the filament to the plate of the ordinary radio triode.

Broadcasting Invades the Philippines

IN THE last session of the Filipino legislature a bill was passed granting a franchise to the Radio Corporation of America and two other concerns for the operation of radio broadcast service in that province. Governor Leonard Wood has just signed the bill, so that probably within the

OLD SOW RADIATOR

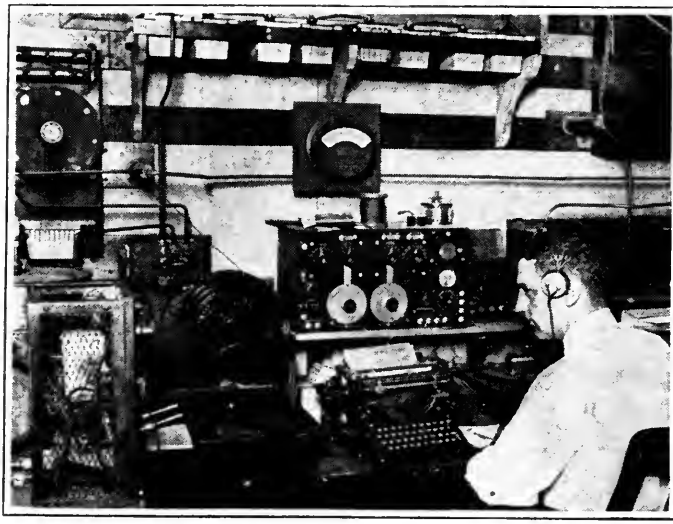
I know an old pest who be-clutters the air,
She has many children—she has 'em for fair;
She gives squealing lessons to all her young brats—
(For sharp oscillations, they have it on cats.)
A selfish old hag—with the sharpest of voices,
In spoiling our concerts she gayly rejoices;
Sing ho!—for a law to put her on the "skids—"
And listen, dear fan—don't raise one of her kids!

—Drawing and verse by W. R. Bradford.

year the Philippines will have their local broadcast channels and occasionally the listeners on these islands will undoubtedly pick up messages from other lands.

Locating the Broadcast Station

IT IS now about two years since the first systematic measurement of radio signals was attempted and carried out. Where evidence about audibility and interference is obtained from untrained, observers as was first done, but little progress in radio transmission development is possible. Real knowledge of radio conditions can be obtained only by making measurements with instruments which can actually be read. It cannot be obtained by comparing the observations of two listeners having no other evidence than that given by their ears.



RADIO IN RETAIL MERCHANDISING

The radio telegraph station WHI at the New York store of John Wanamaker. The Philadelphia and New York Stores carry on a great deal of traffic which was formerly handled by telegraph, letter, and long distance telephone. A five kilowatt arc is used, transmitting on a wavelength of 1700 meters. The operator in the photograph is Douglas Smith manager of the radio department at New York

The next step in radio transmission investigations, after portable receiving apparatus had measured the signal strength in all directions from a fixed transmitting station, was to move the transmitting station itself to compare its performance under different conditions. It is probably true that to serve a large city and its suburbs, a transmitting station should not be in the city itself. If the transmitting station is in the middle of a group of steel buildings, practically all of its energy is absorbed in the immediate vicinity of the station and thus wasted. Much better service would probably be furnished to the city dwellers if the station was located in the country, possibly twenty miles or more away, in the open country where the absorption is comparatively small. Such a location must have good grounding facilities, and therefore actual trials of the location are always advisable before a station site is determined.

Station WJAZ of Chicago and vicinity has been doing just this thing lately. Their 100 watt transmitter, mounted on a truck, has been operated in various locations around Chicago and now a compilation of the data obtained by variously placed receiving stations around Chicago will permit the logical selection of the most suitable location for a new broadcast station.

A German Broadcast Station on a Mountain

THERE are indications from Germany that radio is progressing there, even if not at the rapid pace it has assumed in our country. At Lake Kochelsee in Bavaria a station is being erected which, it is claimed, will be the most powerful in Europe. The antenna will extend along the side of a mountain from the summit to its base, where the station is being erected on the shore of the lake. This will give an antenna two miles long and of rather indefinite height as far as radiation efficiency is concerned.

Following our lead in educational radio, a broadcast station in Berlin has started to radiate some university courses two evenings a week. While intended primarily as a help to those who attend the university, probably some data will be obtained as to the general appreciation of this type of broadcasting.

Is Education by Radio Wanted?

IN AMERICA, it seems likely that the demand for solid educational material is one which has to be cultivated. By far the vast majority of radio listeners regard the radio

MAJOR WILLIAM N. HENSLEY, JR.
Commanding Officer, Mitchel Field, New York

"The adaptation of radio to the airplane has completely changed the aspect of war. Under present conditions, an enemy would have no secrets. To mass troops at any one point would simply serve to inform the opposing forces that an offensive was contemplated. Artillery fire could be directed with such deadly accuracy as to annihilate any stronghold. The gun pointer would have first hand and almost instantaneous information as to the necessary corrections with the result that big guns can be fired with the precision of a rifle"

channel as one through which material for entertainment rather than education should be sent. It is not at all impossible that the educational possibilities of radio have been overestimated. Possibly the contact with the instructor, the opportunity to ask questions, to get his criticism and occasional praise, have a much higher value in the field of education than is generally supposed. The progress of educational radio must depend upon its reception by the public, and the public's demand for it may show conclusively, as has often been stated, that the teacher, and not the method or material taught, is the factor which advances the world's knowledge.

Yap Gets a Radio Station

THE small island of Yap in the western Pacific has several times loomed up in international affairs with a valuation much greater than its physical dimensions and natural riches warrant. It occupies a strategic position in cable and radio communication between the eastern and western shores of the Pacific and assumes unexpected importance, especially for Japan and the United States.

At the Disarmament Conference in Washington, Japan was granted mandatory powers in Yap, with the provision that other interested nations should have equal rights with Japan in the use of its communication facilities. Japan now announces her intention to erect next year a powerful radio station in Yap, presumably to increase the certainty of her transpacific communication channels. Undoubtedly the new station will be used for relaying. In that rôle it would be useful also to the United States when static interferes with the long spans over which our present circuit to Japan extends.

Coöperation in Solving Interference

IN A recent issue we had occasion to commend the activities of Mr. Alfred Caddell of the American Radio Association and used as an illustration of the work he was attacking with success the question of interference in the broadcast channels caused by the steamers of the New England Steamship Company, which carried on a heavy commercial traffic with spark transmitters.

The interference was there without any doubt, and we quite naturally commended Mr. Caddell for the lively measures he was taking to eliminate it. We have received a very courteous letter from the president of the Steamship Company asking us to assure the broadcast listeners that his company was anxious to help in clearing up interference as much as possible. In accordance with the recommendations made at the last radio conference the ship traffic is now being carried on on a wavelength much farther removed from the broadcast channels than the originally interfering wave of 600 meters, and he hopes the interference nuisance has been done away with.

His letter, however, contains one naïve statement which we think worth while passing along. "I get no interference from these steamers," says Mr. Parnell, "although I use a simple set consisting of three stages of radio frequency, a detector, and three of audio frequency, seven tubes in all." Well, naturally, he gets no interference. Three stages of tuned radio frequency will eliminate a whole lot of interference, but surely this is a rather expensive equipment to expect the average broadcast listener within a few miles of New York to use. If all the listeners who have

been bothered by the ship traffic would put in three stages of tuned radio frequency, the interference problem would unquestionably be solved, but the expense involved for the listeners might in the aggregate be sufficient to buy out the Steamship Company. An easier and more equitable solution, which we feel sure will more likely meet with commendation from the broadcast listeners, is for Mr. Parnell to order his ships to use their spark sets no more than absolutely necessary during broadcasting hours, and we are sure from the tone of his letter that suggestions of this kind will be complied with as much as possible.

HERBERT H. FROST

Chicago; President, Radio Manufacturers' Association

"By next summer, the new high power broadcast stations, authorized at the recent Washington radio conference will be in operation and they will make it possible for the farmer to receive his market and weather reports during daylight hours. Heretofore, such reception has been difficult, which kept the farmer from buying radio. Now, probably not more than fifteen per cent. of the American and Canadian farmers have receiving sets.

"The best engineers in the country are of the opinion that there will be no fundamental changes in radio receiving equipment in the next few years. Development in this respect is bound to be gradual and there is no danger that a person will secure a good set to-day and to-morrow find it obsolete.

"Radio has ceased to be a fad. It is the greatest source of communication since the first language was developed."

Interesting Things Interestingly Said

MAJOR GENERAL GEORGE O. SQUIER (United States Army, retired: former Chief Signal Officer): "A world-wide net of electrical intercommunication linking together radio, land lines, and submarine cables in a new-born spirit of closest coöperation must be developed to the limit of possible usefulness, both for the needs of peace and as a powerful agency in preventing war."

GEORGE J. ELTZ, JR. (New York; Treasurer, Radio Apparatus Section, Associated Manufacturers of Electrical Supplies): "A large number of people who have been indifferent to the appeal of radio have just awakened with a start to find that the art has been making great forward strides. Moreover, radio has taken on a new artistic nature. When broadcasting first began, there was the attractive novelty of drawing music and speech from the air, and just what came mattered little, but now the main interest is in the quality of the entertainment and the perfection of its reproduction. A critical interest is being taken in programs, which is brought forcibly to the attention of broadcasters by the thousands of letters they receive each day."

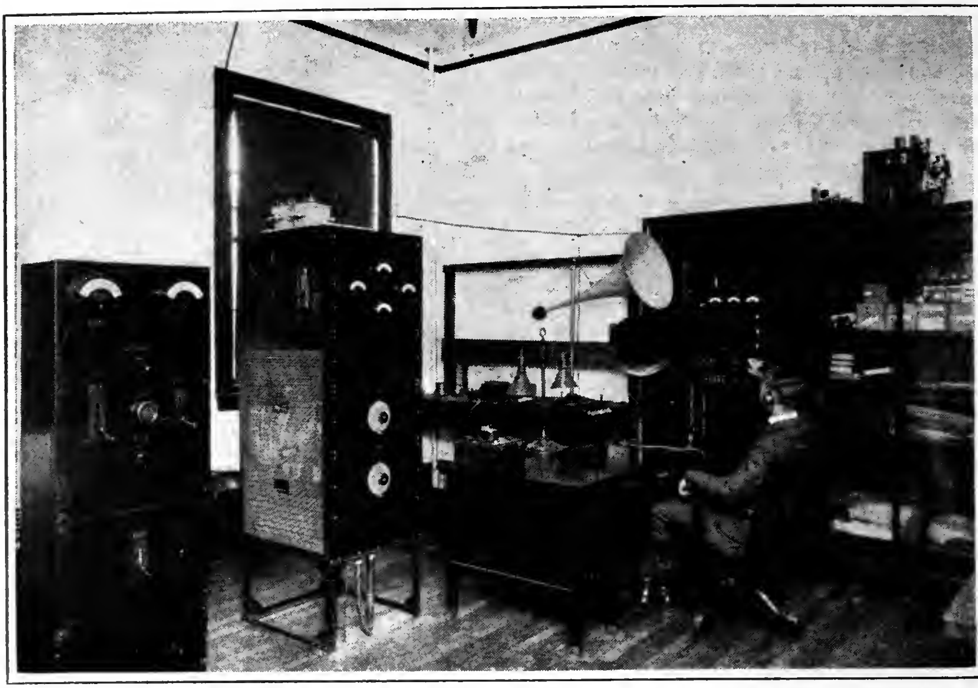
HARRY L. FOSTER (travel writer, in *A Gringo in Mañana Land*) tells of hearing a radio concert in the Honduran wilderness at the house of a mine superintendent at Rosarie): It was as clear as though one listened-in from New York. Out there in the wilderness, forty miles from the nearest town, and many hundred miles from a railway, gringo energy had produced all the comforts of home.

"'That's Vincent Lopez in the Pennsylvania Grill,' the superintendent informed me. 'Wait until I get Schenectady, and we'll have a bedtime story.'"

WILLIAM M. BUTLER (United States Senator from Massachusetts): "Citizens who heretofore regarded politics as an incident in the life of the nation have now, thanks to radio, a keener insight and a fuller appreciation of political activities. I have been much impressed with the political importance of radio as illustrated during the progress of the national conventions. I think that those of us who listened-in must have had sober moments when from the convention hall, the actual voices of the delegates came to our ears as well as the disturbances and interruptions."

H. P. DAVIS (Pittsburgh, vice-president, Westinghouse Electric and Manufacturing Company): "International broadcasting, as I have consistently stated in the past year, must take its place as a regular feature of broadcast programs, and this may come in the very near future."

CHILDREN Sing for WBZ," says a headline in a Boston paper. Which goes Castoria one better.—*Boston Transcript.*



STATION WHAZ

At Rensselaer Polytechnic Institute, Troy, New York was one of the first college broadcasting stations to be installed. It is pointed out that a college broadcasting station is quite as good an advertising medium for such an institution as it is for a radio manufacturing concern

Who Owns Our Broadcasting Stations?

By DUDLEY SIDDALL

MR. B. C. PHANN, his wife and kids, aren't using their radio set as they used to. Six months ago it was a novelty. At first the whole Phann family came a-running at the mere cry of "Here's some DX!" But after a few weeks the thrill wore off. To-day the Phanns wouldn't sit up till midnight to hear Havana.

The Phann family has become discriminating. Nothing less than a surpassingly good radio feature will keep them away from movies, theatres, magazines, books, and other diversions. Radio no longer intrigues them with its mechanical mysteries. The loud speaker is now forced to compete for their time and attention on an equal basis with other forms of entertainment, amusement, news and education.

The movies, starting with men whose imaginations ran no farther than a single reel "chase" picture, soon produced directors like D. W. Griffith. The theatre has its creative geniuses like David Belasco. Magazines are edited by men who appear very definitely to know what the public wants, such as George Horace Lorimer and Ray Long. Books, when written by Gene Stratton Porter or Edna Ferber sell by the hundreds of thousands. In every line except radio, huge incomes await men and women who can capture public interest.

Analysis of information showing the owner-

ship of broadcasting stations proves beyond question, if there were any question, that the vast majority of broadcasting stations are operated largely for advertising purposes: in other words, as a feeder for the broadcaster's real business interest, his radio store, his garage, his jewelry shop, his clothing store, or his dance hall. So there are many who claim that the radio broadcasting station has much in common with the old time, now almost historical patent medicine vendor's show. It is, basically, they say a bally-hoo. Obviously no bally-hoo can hope to approach the proportions of grand opera, a feature film, or a Broadway theatrical production.

What the Idea Is

Many radio listeners have often asked themselves, or what is more to the point, others, who owns all the vast numbers of American broadcasting stations. Those who tune-in, night after night, to the more or less varied programs from every section of the nation, should be, and usually are, interested in knowing the ownership of the stations figuratively knocking at their antenna insulators each evening. Mr. Siddall has analyzed the ownership of our 550 stations and has included some interesting remarks of his own about the general problem of who is broadcasting, how they are doing the job, and what is likely to happen to broadcasting. According to the estimate of the writer, it takes roughly 11,000 separate features to supply American broadcasting programs for one day. Is there that much talent in the country to supply material for each of the 365 days?—THE EDITOR.

CASES IN POINT—WITHOUT NAMES

CONSIDER a specific station, in a Southern state. In 1922 an electrical store put in a line of radio supplies. To draw trade, the dealer installed a 500 watt transmitter and hired a local newspaper reporter on a part time salary of $20 a week as "director." This reporter is also the announcer, the publicity man, the scout for talent, and all the rest of the non-technical staff. One of the store clerks serves as the engineering department of the station. The "director" has long since made the rounds of such local talent as can be induced to sing, play, or talk. He has no fund to hire artists or even to buy them dinners and taxi rides. All things considered, he does fairly well; but he has no opportunity to give his radio audience anything better or bigger or newer or more impressive than as if he were directing a Sunday school social entertainment.

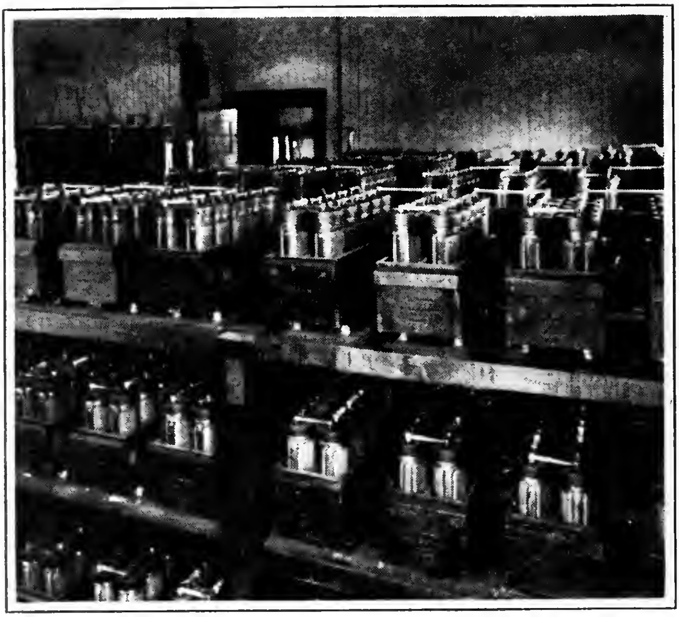
The dealer who pays the small weekly bills for this station charges the expense to advertising and is content. At heart he is an electrical retailer. Even if he were willing to spend $2000 a night on talent, which he isn't and never will be, he wouldn't know how to do it.

Another case: A chief executive in a metropolitan city plays with radio as a hobby. His real job is selling building materials. He cheerfully writes out a small weekly check to support a broadcasting station just for the fun of the thing.

Much the same sort of a motive is back of a station operated by a large service company. A high executive in the organization is a radio enthusiast. He is so high up that nobody questions his right to use company time, men, and money to build a transmitting station, nor to pay a part-time salary to a publicity expert to "direct" it. Ostensibly the station is run so "that employees may be benefited." Thus the bills pass the auditing department under the general heading of welfare work. But those on the inside like to call this station "the chief's toy."

Newspapers, not knowing exactly what effect radio was going to have on their business, went into broadcasting on a fairly large scale to find out. Many of them did find out, and soon there was a lot of transmitting apparatus in newspaper storage rooms for sale cheap. A few papers, strategically located, have been able to make broadcasting pay by adding special radio sections to their Saturday or Sunday issues. Because the papers with broadcasting stations stand out as "radio mediums" they garner most of the radio advertising in their territories. These exceptions will stick to broadcasting as long as radio advertising volume holds up. Since the expense is usually charged to "promotion" it is certain that no radical artistic program innovations of an expensive nature will ever come from this source.

Nor can the public expect anything very highly artistic or highly important from the municipal stations, of which WNYC, New York City, is a notable example. Whether or not a municipal station is, as has been charged, a bally-hoo for the politicians is of no importance. The fact remains that tax-payers



MANY PURELY COMMERCIAL CONCERNS

Have gone into broadcasting, presumably directly to influence their sales. This photograph shows the bank of batteries used to run the station which is maintained by a battery manufacturer

would resent any lavish expenditure for talent on the part of a municipal broadcasting station. City officials are not elected for the purpose of giving nightly musical entertainments. So, while municipal stations may perform certain modest functions very capably, the people who sign "Irate Tax-payer" to their letters "to the editor" can be depended upon to sit on the municipal lid.

HOW GOOD A JOB IS BEING DONE

EDUCATIONAL institutions, churches, national guard, chambers of commerce, hotels, department stores, grain and feed establishments, monument dealers, lawyers, a chiropractic school, newspapers, music-stores—so runs the list of broadcasters. Plainly, they are using radio to advertise everything from the Gospel to "$2 Dinners With Dancing."

Day after day and night after night these stations pour forth programs. Take a pencil and figure out the staggering quantity of stuff that is annually being pushed into the air. Suppose each of the 550 broadcasting stations operates two hours a day, and suppose that the average length of each program number is six minutes, or ten items an hour. Multiply 550 by 2 by 10. The answer is 11,000; for this is the daily number of program items required to fill in the time of America's broadcasting stations. Now multiply 11,000 by 365, to get the annual number of items. The answer is 4,015,000. If you're conservative, cut this in two and you'll find that at least 2,000,000 songs, dance numbers, sermons, Republican, and Independent conventions, talks on the rubber heel industry, and bedtime stories have to be gathered and disseminated annually by the broadcasters. The wonder is, not that they do such a bad job, but that they do such a good one.

Broadcasting is still very young. It began in September of 1921. In January, 1922, the licensed broadcasting stations numbered only 28 for the whole United States. By fall, or October 1 to be exact, the number had jumped to 539. At that point the swiftly rising curve flattened out and ever since then the number of licensed broadcasters has hung around the 550 mark. On July 1, 1924, there were 549 stations; only ten more than on October 1, 1922.

The mortality is heavy; as many as 80 stations having been deleted from the list in a single month. Twenty deletions is about the average. Always, however, other new and hopeful advertisers have come along to throw their waves out into the great unknown, so that the total number of stations steadily stays between 500 and 600.

Of the 549 stations which were licensed up to July 1st, last year, 224 were pretty definitely advertising radio. That is, these 224 stations included radio manufacturers, radio jobbers, radio stores, garages handling radio equipment as a sideline, department stores featuring radio sections (of which there were 20), and music stores which were taking no chances on having their phonograph and piano business literally vanish into the air. To this classification could be added 11 stations operated by such concerns as the American Telephone & Telegraph Co., the General Electric Co., the Radio Corporation of America, and public

utilities which are in radio either for sales or experimental and patent motives. In other words, 235 or about 43 per cent. of the broadcasting is now being done by firms who have a direct interest in the radio industry.

EDUCATIONAL INSTITUTIONS NEXT TO RADIO

NEXT to the radio industry come the educational institutions with 92 stations. They are delving in broadcasting slightly, very slightly, from scientific motives; but largely, very largely, one may confidently assume, from the same advertising motives that impel them to build up strong football teams. Since October 1, 1922, the number of "educational" broadcasting stations has increased by 50 per cent.

Newspapers come third with 42 stations, just a little more than half the number operated by newspapers two years previously, before the worried business managers found they had little to fear from radio.

Fourth on the list are religious organizations with 31 stations; three times as many as on October 1, 1922. Presumably there would be many more of these "air churches" if more religious organizations had the money to build and operate them.

Miscellanous business establishments, ranging from a song book printer to a dance hall, account for 23 more. Municipal, national guard, chamber of commerce, and other community stations number 21, while clubs of various kinds operate 10 stations. Broadcasting is being indulged in by 7 theatres and 5 hotels. Added to all these is a group of 83 stations, chiefly of low power, in the hands of private owners and small business houses.

WHERE WE ARE NOW

IT IS not the purpose of this article to present any of the numerous schemes for bettering broadcasting, but simply to show the sources from which America's programs are now coming. And yet, on behalf of Mr. and Mrs. B. C. Phann and the Phann children, this word might be added:

This year Mr. and Mrs. Phann are spending $350,000,000 on the mechanics of radio: that is, for parts, sets, batteries, tubes, and the rest of the paraphernalia. They are spending, practically, one million dollars a day not to count the hours and hours of time.

For this time and this money they are getting nothing, fundamentally but advertising in one form or another. They are getting the bally-hoos of political leaders, of ball clubs, of fighters, and football teams. They are getting the bally-hoos of hotels which have dance orchestras. They are getting the bally-hoos

THE ST. LOUIS "POST DISPATCH"

Has successfully operated station KSD for some time. This newspaper is one of a number of great newspapers in the country which has entered whole-heartedly into the "business" of broadcasting

© Western Electric Company

STATION WCBD

Zion City, Illinois, is owned and operated by the religious community there under the direction of Wilbur Glenn Voliva. Entertainment and religious programs are regularly broadcast from this station

of actors (for the most part out of jobs) who want to "keep their names before the public." They are getting the bally-hoos of churches, of health departments, of colleges, and of popular music publishers.

The fact that a portion of these bally-hoos are good is utterly beside the point. The issue is that broadcasting of to-day is all bally-hoo—the advertising of something. The radio fans who are spending a million dollars a day are entitled to more than that. Radio, to grow into an art as the movies have grown into an art and to compete with the movies, theatres, and other arts, must find new and better food for its head phones and loud speakers. It must find inducements for directors of genius and artists of ability: men and women who can express themselves to the multitudes through the sense of hearing just as the creators of the movie art have, in twenty years, learned to translate artistic expression into terms of sight.

When that day comes, the public which is spending a million dollars a day on radio mechanics will gladly spend twice or three times as much on radio art.

"NOW, I HAVE FOUND. . ."

A Department Where Readers Can Exchange Ideas and Suggestions of Value to the Radio Constructor and Operator

FOR a long time, RADIO BROADCAST has felt the need of an outlet for the many excellent ideas dealing with various features of radio construction which reach our office. With this issue, we begin the department of good ideas from our readers, and invite the coöperation of all those who are interested.

If you have an idea about a valuable and useful new circuit, some new device, a construction or operating suggestion, we should like to have it. Payment of from two to ten dollars will be made for every idea accepted. The descriptions should be limited to three hundred words and typewritten. Accompanying sketches, drawings, and circuit diagrams should be as plain as possible.

We do not want simple, obvious suggestions. Material to be acceptable for this department must offer something of definite value to the constructor. Mere novelty is not desired. Address your manuscripts to this department, RADIO BROADCAST, Garden City, New York.—THE EDITOR.

A FORM FOR ROBERTS COILS

THE easiest way is to make a tin template to start with, from which any number of forms may be made, which will be handy when your friends hear your Roberts set and want to make one like it,

Cut a circular piece of tin $4\frac{1}{2}''$ in diameter;

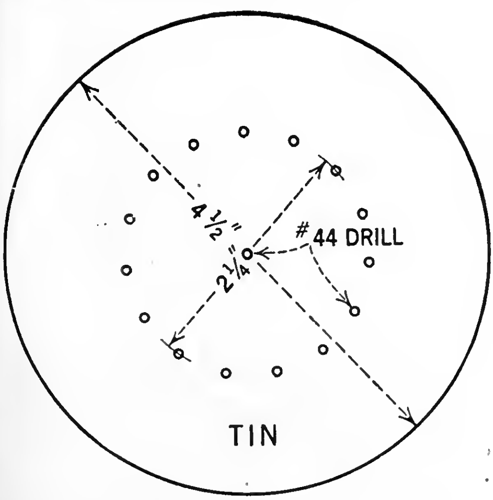


FIG. 1

then strike a circle on this piece $2\frac{1}{4}''$ in diameter. Set the dividers a little less than $\frac{1}{2}''$ and starting at a mark on the $2\frac{1}{4}''$ circle, "step" the dividers around the circle counting the steps, the object being to make 15 divisions on the circle. This will take several trials and some patience. When at last you have the dividers set right, mark the 15 divisions and center-punch them. Drill them out with a small drill, No. 44 or smaller. Drill the center hole with a No. 19 drill. See Fig. 1.

Cut out 5 pieces of $\frac{1}{16}''$ either red or black fibre $4\frac{1}{2}''$ in diameter and drill the center hole with a No. 19 drill. Bolt the template to one of the fibre pieces with an $\frac{8}{32}$ screw and run the small drill through the fibre using the holes in the template to guide the drill. Take off the

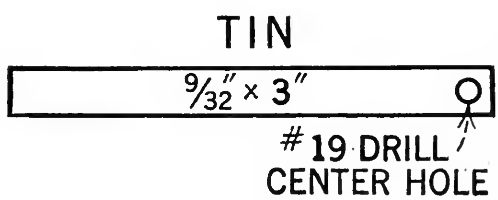


FIG. 2

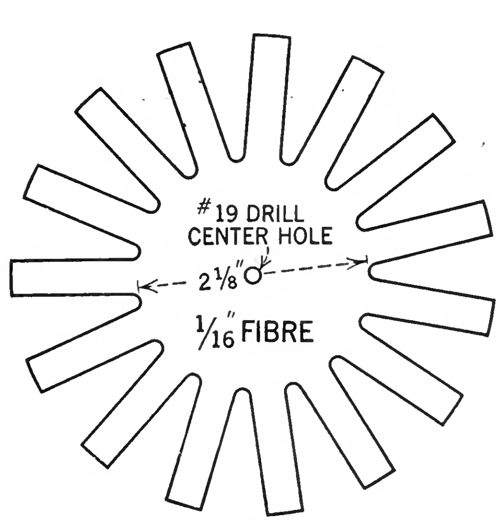


FIG. 3

template and ream out the holes in the fibre with the No. 19 drill.

Cut a strip of tin as shown in the sketch Fig. 2 and bolt it to the center of one of the fibre circles. Mark the spokes with it using a scratch awl and not a pencil, then cut on these lines with the tin snips and you will have a perfectly good form. See Fig. 3.

The forms should be boiled in paraffin for about ten minutes before winding or they will absorb moisture. After they are wound, the coils may be painted with a thin solution of celluloid dissolved in acetone.—HARDING GOW, East Sound, Wash.

A FILTER FOR THE SUPER-HETERODYNE

IN PUTTING up a super-heterodyne along the lines of Mr. McMurdo Silver's set, using Acme 30 kc transformers, I found that the filter suggested, though not recommended, caused considerable distortion (due possibly to the cutting off of some of the

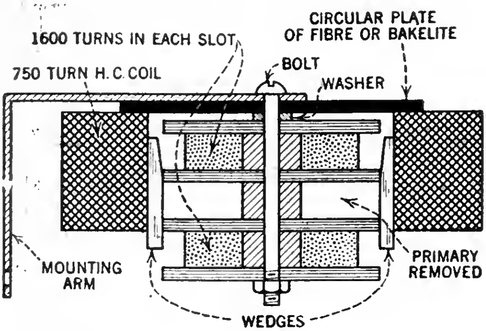


FIG. 4

side bands). I then worked out a filter which not only produced no distortion, but which also brought about sharper tuning and more volume.

I removed the primary of 800 turns and placed the form bearing the two secondary coils, as described in Silver's filter, inside a 750 turn honeycomb coil providing the necessary mechanical support as shown in the sketch Fig. 4.

Connect the small coil as an untuned primary and shunt the honeycomb coil with a .001 mfd. variable condenser or approximately .0005 mfd. fixed condenser making this the secondary of the filter. With this substitution and using the Acmes in the two intermediate R. F. steps I could not ask for a smoother operating set than McMurdo Silver's set as described in October RADIO BROADCAST.—F. S. WHITE, Syracuse, N. Y.

A PICKLE-BOTTLE COIL FORM

HERE is a stunt that you might pass on to your readers so that pickle-bottles will be not in such great demand for coil-winding purposes.

In a circle, inscribe an octagon of the size required for the coil to be wound, as in Fig. 5. Next, cut a strip of tin A-A′ long and about $2\frac{1}{2}''$ wide. See Fig. 6. Allow $\frac{1}{4}''$ at each end for a joint. Bend and form the joint first, then fold at B-C-D etc., to obtain the shape as shown in Fig. 8. Bend a piece of tin for a clamp, or slot a thin-walled brass tube so it will slip over the flaps as shown in Fig. 7.

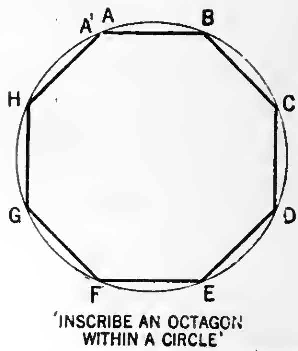


FIG. 5

Small angles of tin may be soldered at one end of the completed form to guide the wire in a smooth, straight manner. Wind the turns closely together and when the proper width of coil has been wound give it a light coating of "dope" consisting of celluloid dissolved in acetone. The demountable form may be removed by withdrawing the slotted tube first.—R. B. CLAPP, Cleveland, Ohio.

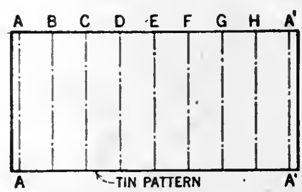


FIG. 6

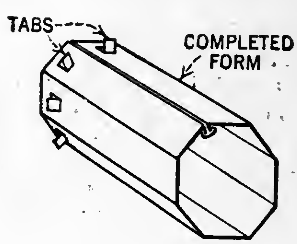


FIG. 7

FIG. 8

ANOTHER WAY OF WINDING THE COILS FOR THE K. O. CRYSTAL REFLEX RECEIVER

IN WINDING the T1 and T2 coils used in the RADIO BROADCAST Knockout crystal reflex receiver, I am pleased to submit an idea of my own for getting clear of the trouble of supporting the leads for the primary, or smaller winding.

First, wind the primary on a tube of the proper size for the entire unit and bring out the leads as shown at A, Fig. 9. This keeps the primary winding tight. Next, place empire cloth or any other form of insulation, on each side of the primary to build up an even layer as at B. Then put on a wider piece of cloth the full width of the secondary coil as at C. Next, wind the secondary and bring out the leads as for the primary as shown at D. The result is a smooth layer of wire with no leads shown. The main point is that all the coils are tight. This system is better than when the primary coil is wound on top of the secondary.—W. A. WEST, Hopewell, N. S.

USING STANDARD COILS IN THE ROBERTS CIRCUIT

HERE is a suggestion that might be of interest to your readers. Most of the ready-made coils for the Roberts circuit are rather costly and in some instances appear to be somewhat weak mechanically as regards the adjustment of the tickler.

I have used two Crosley Varinds such as is shown in Fig. 10 and while I have not a permanent installation, they give promising results. The tapped coil on one of the Varinds may be used as a single circuit for the primary or may be used as the primary and secondary of the antenna coupler by dividing it into two sections as shown in Fig. 11.

On the second Varind, the tapped coil was replaced with a winding of larger-sized wire for the secondary, the sliding coil used as the tickler, and the coil intended for the tickler on the first unit, constituting the N-P form. See Fig. 12. This latter coil must be rewound with a pair of wires to provide the N-P winding.

A pleasing panel appearance is produced and the units are mechanically substantial. —C. C. SHUDER, Sumner, Ill.

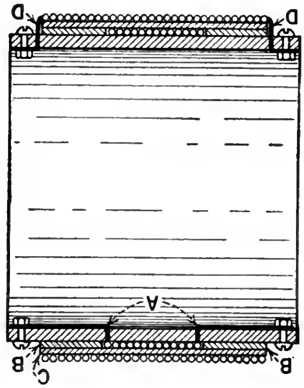
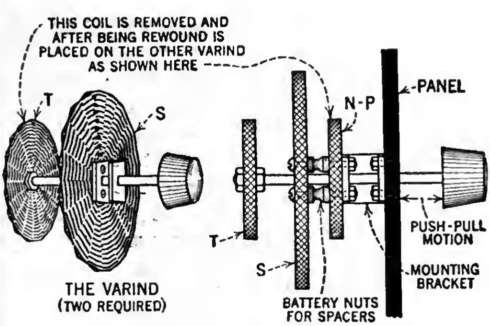


FIG. 9



FIGS. 11 AND 12

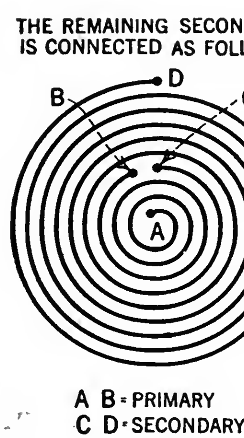
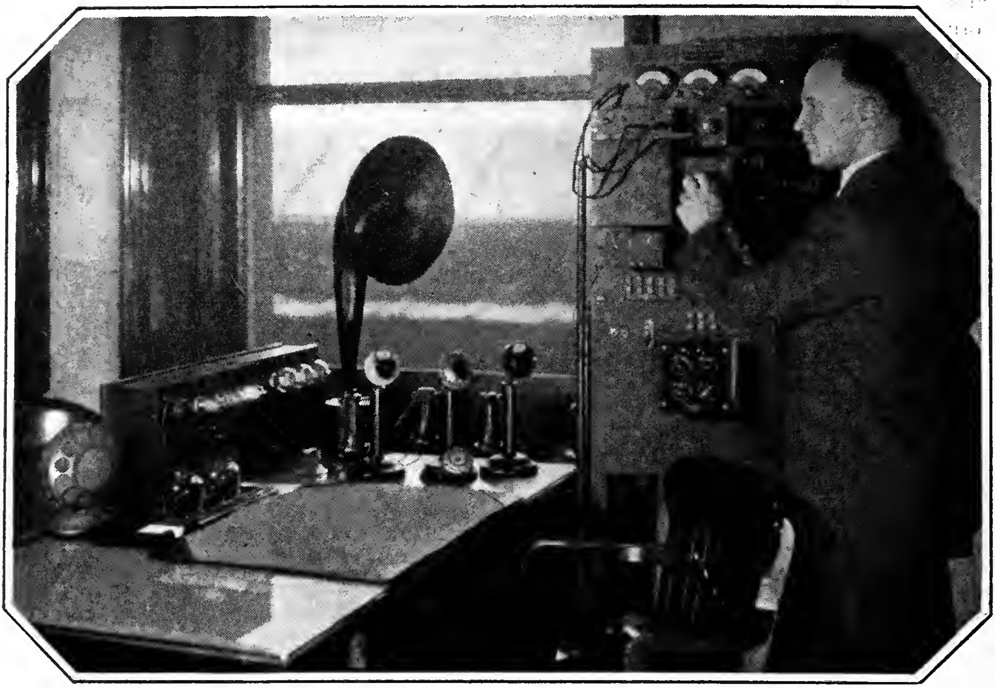


FIG. 10



THE CONTROL ROOM AT STATION WJAX, WHERE SOME OF THE RADIO DRAMA OCCURRED

Our Busiest Day

When Two Political Conventions Were Going on at the Same Time—Some Interesting Sidelights on the Life of a Broadcasting Station Engineer—What Goes on Before the Curtain is Raised

By DON S. KNOWLTON

Manager, station WJAX, Cleveland, Ohio

JULY 4, 1924, was the busiest day we ever had at station WJAX.

The excitement really started several days before, when we hooked in on the American Telephone and Telegraph Company wire tie-up and began broadcasting the National Democratic Convention from Madison Square Garden in New York. After that had been going day and night for a week the boys in the station began to get slightly weary and every time the words "twenty-four for Underwood" came through, the gang set up a cheer you could hear from one end of the twenty story Union Trust Building to the other.

To top that, along came the Filipino Orchestra from the S.S. *Leviathan* on a radio broadcasting tour. They were due to broadcast over our station on the evening of July 3rd.

We had the machinery all set up so that this *Leviathan* orchestra could do their act down in the lobby of the Hotel Cleveland and we had our remote control panel and our line installed to do the broadcasting from that location in the evening.

And then the Democrats kept right on gumming things up. Of course, we had expected that the Democrats would get through nominating and go home by that time, but they didn't. They kept right on going during the day hours of July 3rd and started in on a long evening session. Would the Democrats get through in time for us to broadcast the *Leviathan* orchestra, or wouldn't they? The *Leviathan* crowd had to make a train at twelve o'clock that night.

While we were stewing about that, in came the word that we were to broadcast the La

Follette Convention from the Public Auditorium in Cleveland the next day, July 4th!

That certainly did set the electrical kettle boiling.

Here we were all tied up with a Convention coming in from New York, sitting around waiting to work in the remote control job from the Hotel Cleveland, and along came the news that we would have to get our hook-up all set down at the big Public Auditorium in Cleveland for still another job, beginning at ten o'clock the next morning!

Well, Thorburn, our engineer, and Johnson, our announcer, work on the theory that nothing is impossible. If it had to be done, it had to be done, that was all.

THE DEMOCRATS CONTINUED BALLOTING

THE Democrats kept right on balloting. They balloted so long that the *Leviathan* orchestra didn't get a chance to broadcast at all. So at eleven o'clock that night, Johnson rushed our remote control panel from the Hotel Cleveland down to the Public Auditorium and began to get all set for our installation down there. He worked until about two in the morning and then the boys decided that sleep was more important at that time than any microphone or control panel in the world.

At six o'clock the next morning they were back again at the Public Auditorium and completed their installation. This consisted of a tie-up with the public address amplifying system already installed in the auditorium.

While the boys were working on that, we had to set up our glass broadcasting booth on the stage of the Public Auditorium just behind one of the wings, as near as possible to the speaker's platform. At four o'clock of the afternoon of July 3rd, this broadcasting booth lay knocked-down in several pieces up in the storeroom of the twentieth floor of The Union Trust Building. Between four o'clock that afternoon and eight o'clock the following morning, movers took the sections of this booth down to the Public Hall, a building company put the thing together and set it up, and then our remote control panel had to be installed inside of the broadcasting booth and the lines tested.

THE LITTLE OLD LADY IN BLACK

THE Convention was due to open at ten o'clock. At a quarter of ten the boys were almost desperate. It didn't seem possible to get the job done in time. Three minutes of ten—two minutes of ten—at last the installation was complete and they made the test.

The test was rotten!

Something was wrong. The tie-in with the general amplifying system didn't work worth a hoot.

The Chairman mounted the platform with his gavel in his hand.

"Oh! what's the use," Johnson cried, and slammed a pair of pliers on the floor.

But just then we had a life saver.

A little old lady in a black dress and a black hat—I don't know who she is, but she certainly saved our lives—came bustling up on the platform and she said to the Chairman:

"But we haven't rehearsed our songs yet. We must rehearse our songs."

"But," the Chairman objected, "we have got to start this Convention, it's due to start at ten o'clock."

"Well, the Convention will just have to wait until we rehearse our songs!"

The Chairman gave up, and the old lady gathered about her a group of women who began to rehearse the various La Follette songs which the convention was going to sing.

Suddenly Johnson had an inspiration.

"Well! we can try it," he said, "we will see if we can't put in our own installation."

If you think you know what fast work is, you ought to have seen the boys fly around during the next few minutes. They tore out entirely the hook-up with the amplifying system, got their own microphone and put in their usual remote control plan of installation, running the cord from the remote control panel through the roof of the broadcasting booth, down to the floor, under the chairs of the delegates who were seated there, and up on to the speaker's platform.

The installation was almost complete—all that was necessary was to place the microphone up on the top of the speaker's platform —and then—a terrible catastrophe.

The cord wasn't long enough! It wouldn't reach! It lacked two feet!

The ladies stopped rehearsing their songs and once more the Chairman mounted that platform with the gavel in his hand.

I wish you could have seen Johnson's face when he saw that that cord wasn't going to reach.

Life just wasn't worth living any more, that's all there was to it.

And then somebody had a bright idea.

"You doggone fool," he yelled, "if you stretch that cord from the top of the booth to the top of the platform instead of running it

down underneath the chairs, it will be plenty long enough!

So while the Chairman of the Convention stood on the platform with his gavel up-raised, ready to call the Convention to order, we were frantically stretching that cord from the booth to the platform, and one of us holding it in place while the other nailed it down.

Bang! went the last nail into place, and at almost the same instant, bang! went the Chairman's gavel and the Convention was on.

At the same instant Johnson was back into his booth,—"This is station WJAX, The Union Trust Company, Cleveland, broadcasting. . ."

The La Follette Convention was in the air!

Well, we went back to the studio and fell flat on the carpet for a few minutes' rest.

TWO CONVENTIONS AT ONCE

THEN the Democrats began to get busy. First came a lot of brass band music and then the invocation and then the reading of the Declaration of Independence address. The thing got under our skins somehow, and as hardened as we were to the radio game we sat up and took notice.

There we were with two loud speakers in the station. Through one was coming the proceedings of the National Democratic Convention in New York about to nominate a candidate for President. Through the other was coming the proceedings of the La Follette party in Cleveland, preparing to nominate La Follette for the presidency. Our radio audience was getting only the La Follette Convention, but we were getting both at the same time!

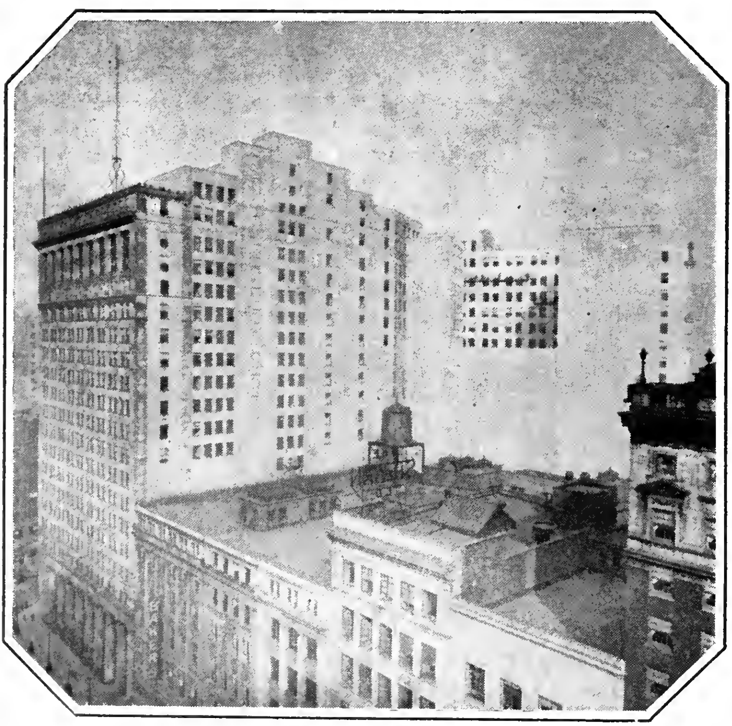
Down at the Public Hall in Cleveland a La Follette orator was denouncing what he called the "mad-house" at New York. At the same instant we heard the "mad-house" at New York going full blast.

We left the La Follette Convention in the air until the Democrats had finished their singing and the reading of the Declaration of Independence, and the Chairman's gavel sounded the call of the Convention to order. Then the writer stepped to the microphone and said, "Well, friends of the radio audience, we are now going to switch you over from the La Follette Convention at the Public Auditorium in Cleveland to the National Democratic Convention in Madison Square Garden in New York City."

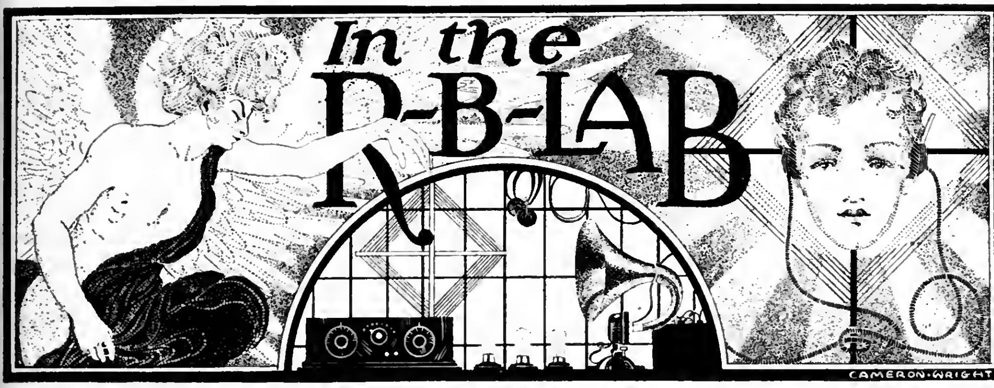
Click, went the switch in the operating room and the radio audience jumped from Cleveland to New York, from La Follette to the Democrats, and once more were privileged to hear the repetition of that now world-famous phrase, "Twenty four for Underwood."

Then late in the afternoon, when the Democrats had finished their daily round and adjourned, once more we switched our listeners from Madison Square Garden back again to the Public Auditorium in Cleveland, where young Bob La Follette was making an impassioned plea on behalf of his father's candidacy.

It was a wonderful, wonderful day, but I can tell you that after it was all over, the most glorious thing of all was to go home and to bed for one good long ten hour stretch.



THE TWO ANTENNA TOWERS
Atop the Union Trust Company building in Cleveland, owners of station WJAX



LOSS STABILIZING R. F. CIRCUITS

THE greatest problem encountered in design and construction of radio-frequency amplifiers is the stabilization of the system in which they are incorporated—the dissipating or nullifying of the very strong tendency toward oscillations. This tendency is evident in each r. f. circuit, but is most emphasized *in the second stage of a two-step tuned radio-frequency amplifier*—or in the second and third stages of a three-step intensifier. In general, this tendency may be combatted in two ways—by counteraction, and by losses or absorption. Representative of the first method is the neutrodyne and the reversed feed-back systems, though in a narrow sense, these systems may also be considered as functioning through the introduction of losses. The neutrodyne and reversed feed-back method are fairly well known and have been described at length in various issues of Radio Broadcast. The reader is perhaps less familiar with the loss systems, the advantages of which have been strongly emphasized in recent experiments in this laboratory.

Loss methods of stabilization are just what the name suggests. Losses are introduced in the various circuits, in which there is present an oscillatory tendency, of such a magnitude that the surplus energy which would ordinarily be utilized in starting and maintaining oscillations is harmlessly dissipated. At first, the general principle of the thing may appear all wrong. The idea of deliberately introducing losses seems contrary to the fundamental precepts of radio. To-day, much effort is made to reduce all losses in circuits through scientifically designed coils and condensers. However, losses can be made very useful and are quite justified when *properly* used for stabilization. In such arrangements the losses are so adjusted that oscillations are just a little more than stopped. This permits regeneration and a practical maximum in signal strength, sensitivity, and selectivity. (We write "practical" because all of these qualities become still more intensified when the circuit is oscillating—a condition, however, in which enjoyable reception is impossible).

Unfortunately, the introduction of even losses over the entire tuning scale is an ideal condition which, at its best, can only be approximated. The tendency to oscillate increases in any tuned circuit with the frequency. The lower the wave (the higher the frequency) the greater is this tendency.

In the R. B. Lab This Month

—A good method for stabilizing radio frequency amplifiers. A comprehensive discussion of simple and effective means of subduing undesired oscillations in your tuned r. f. set. This complete article is the outcome of a series of experiments in our laboratory.

—A brief description of a six-tube de luxe Roberts Knockout receiver, employing four stages of resistance-coupled audio amplification.

—Charging Edison element B batteries at high charging rates.

—Current carrying capacities of wire sizes in small transformers.

—Other items of helpful interest.

STRAIGHT ABSORPTION

LOSS stabilization systems fall into two classes that we might describe as "straight absorption" and "differential ab-

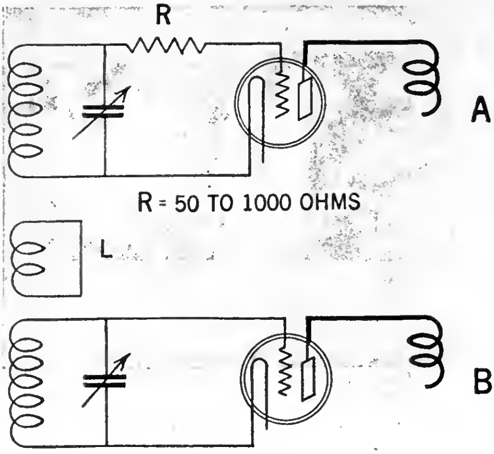


FIG. 1
Examples of straight stabilization

sorption." Straight absorption refers to systems that, without consideration of the changing tendency to oscillate, absorb over the full wave range. This arrangement is obviously very inefficient, for if the system is adjusted greatly to dampen oscillations on the higher frequencies, where a comparatively large amount of absorption is required it will dissipate much more power than is necessary on the higher waves, where almost any set is self stabilizing.

Examples of this type of absorption are numerous and are found in many amateur receivers and in a few commercial sets. The most common procedure is to place a resistance of from fifty to a thousand ohms in the grid circuit of the radio-frequency amplifier, (A, in Fig. 1). Another and widely advocated arrangement is to wind from two to eight turns of wire (L) with a diameter of about two to three inches, placing the coil close to the primary and secondary of the radio-frequency transformer (Fig. 1, B). As might be expected both of these systems work satisfactorily on the low waves where the losses are just sufficient to stabilize the receiver, regeneration with good signal strength and selectivity being permitted. However, on the upper side of the scale, the last trace of regeneration is dampened and the signal itself is absorbed. Variable controls, for obvious reasons, are only an impractical solution.

DIFFERENTIAL ABSORPTION

DIFFERENTIAL absorption refers to those systems that discriminate between the higher and lower wavelengths, and more or less adjust the amount of absorption in proportion to the tendency to over-regenerate and oscillate. Such a system will absorb considerable power on the high frequencies, and practically none at all on the low frequencies, which approaches the ideal condition outlined a few paragraphs above.

A most simple and illustrative example of differential absorption is found in a slight modification of circuit B in Fig. 1. If, instead of short circuiting the terminals of the stabilizing coil L, a fixed condenser is shunted across it, as in LC of Fig. 2 (A), an oscillatory circuit will be formed which will absorb energy only about the wave to which it is tuned. If LC is given a resonance or tuned point at about two hundred and seventy-five meters, it will absorb sufficient power to stabilize the receiver on the short waves, having little or no effect on the higher waves where external stabilization is not required. This is the system first introduced by Austin, in 1916, for the control of oscillations in long wave heterodyne reception, later used by Mr. L. M. Cockaday in a receiver designed by him. This method is at present employed in the two-stage r. f. "Starr" set.

The method just described is probably the most efficient of all absorption methods, and is very easily applied to any r. f. receiver in the course of construction or quite completed. It is only necessary to wind the absorption coils and place them in inductive relation to the secondary. The calculation of the correct number of turns is not difficult.

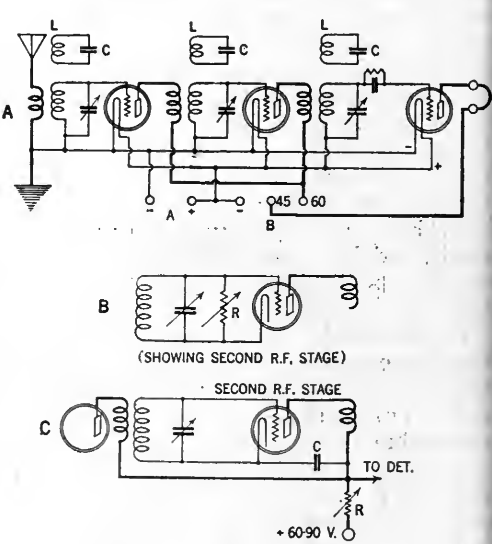


FIG. 2
Preferred and efficient methods of stabilization. The series resistance system (C) reduces the B battery consumption of the r.f. tubes, adding economy to its other desirable characteristics

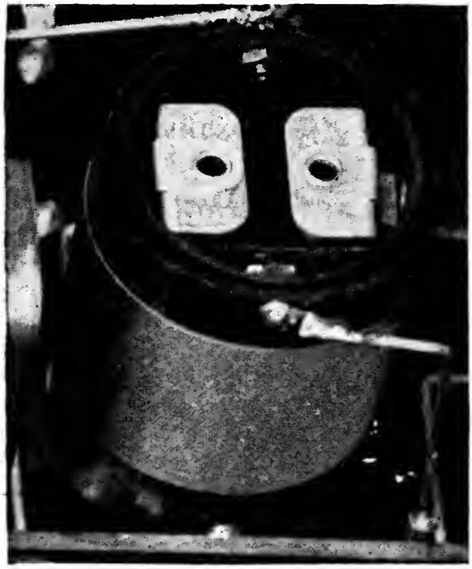


FIG. 3
A tuned radio transformer on the primary of which a stabilizing coil has been wound. The shunt condenser fits nicely within the tube

It is assumed that the resonant absorption coil will be wound on a form approximating the diameter of the secondary, perhaps alongside the secondary, or on a tube that may be slipped within the grid coil. This being the case, the absorption coil should be wound with one half the number of turns on the secondary, and the condenser C should have a value of .00025 mfd. A Micadon will do nicely. This method of mounting the coil and condenser is illustrated in Fig. 3. The absorption coil has been wound alongside of the secondary.

The absorption coil should be wound with no smaller than No. 26 wire. The differential effect is curiously curtailed by the use of very small wire sizes, for the high-frequency resistance of the wire increases with the frequency, which appreciably cuts down the absorption where it is most wanted. In a few cases when the absorption coil tunes over sharply, that is when the circuit oscillates above and below the maximum absorption point, the difficulty can be remedied by winding two or three turns of the coil with resistance wire from a rheostat. This added resistance tends to increase the decrement of the absorption circuit making it tune more broadly, which allows the receiver to cover a larger wave band.

It is advisable to experiment with the coupling between the resonant absorption coil and the receiving circuit. When properly adjusted (though the adjustment is not critical and is easily effected), the set can just be made to oscillate by filament rheostat variation, thus permitting regeneration control that is very desirable and effective. When oscillations occur on such an adjustment they are almost invariably generated in the second tube, seldom, if ever, in the first bulb. Ape-

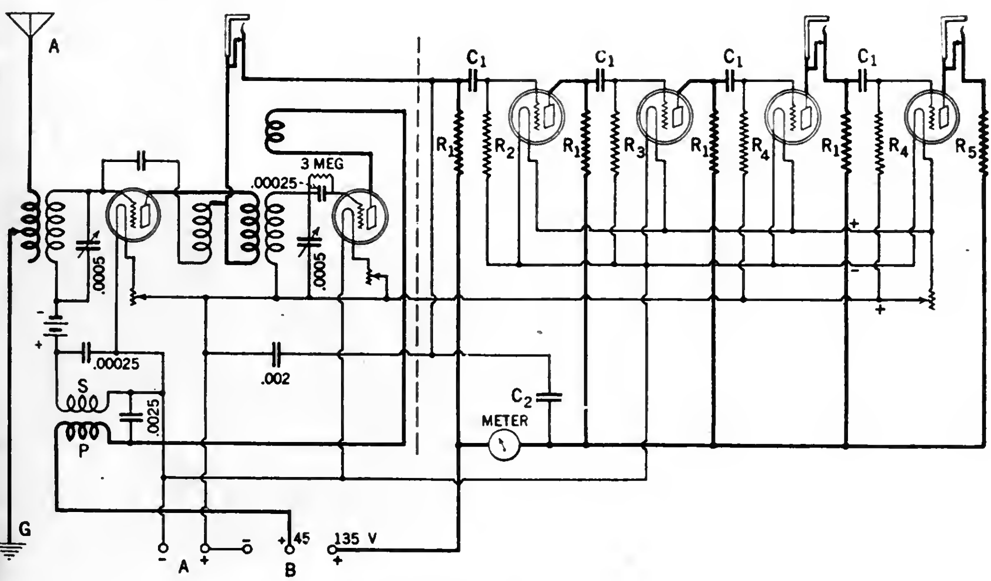


FIG. 4
The circuit of the de luxe six-tube Roberts Knockout receiver

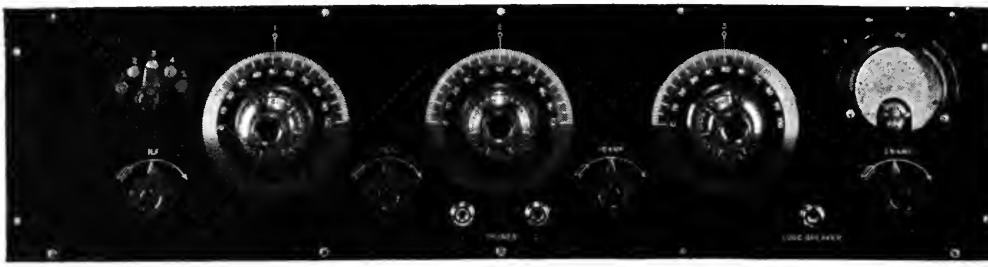


FIG. 5
Front view of the Roberts de luxe receiver. The meter is in the plate circuit of the audio amplifier

riodic primaries are usually found on tuned radio-frequency receivers, which have an actual tuned or resonance point on the low waves which act as an additional absorption circuit at these high frequencies, choking the tendency to oscillate.

In a two-stage tuned r. f. amplifier, the resonant absorption coils should be used in the first and second stage, and in the detector circuit. In receivers already completed, it may be most convenient to wind these coils on separate forms, mounting them in the ends (grid or filament) of the r. f. transformers.

Another interesting, though slightly inferior, method of differential stabilization is the shunting of high resistances (R) across the r. f. tuning condenser (in Fig. 2, B). This has the effect of increasing the "phase difference" of the circuit. The phase angle (unfortunately a rather technical consideration) is a determinant of the power loss in any circuit which increases with the frequency. Hence, the loss will be greater on the higher frequencies or lower wavelengths.

On two stages of tuned radio-frequency amplification, the resistances across the first and third (detector) condensers may be fixed resistors, of the Daven type, having an ohmage of fifty thousand. The resistor across the middle condenser controlling, as we have demonstrated, the least stable of the three circuits, should be a Bradleyohm, having a variable resistance of from ten to one hundred thousand ohms. This, again, will provide the desired regeneration control.

Another very interesting and efficient method of stabilization, though not strictly a loss method, should be considered by the experimenter studying these possibilities. For several reasons, the tendency of a circuit to oscillate, or to become unstable, increases with the plate voltage. Hence, in any fairly stable circuit, for instance, an average r. f. circuit, a gradual reduction of the plate voltage to just below the critical point provides an adequate and efficient method of regeneration control. This principle is employed in the Deresnadyne receiver and in others of similar design. This idea is illustrated in Fig. 2, C.

The resistance R, a ten to one hundred thousand ohm Bradleyohm, adjusts the plate potential applied to the r. f. tubes and detector.

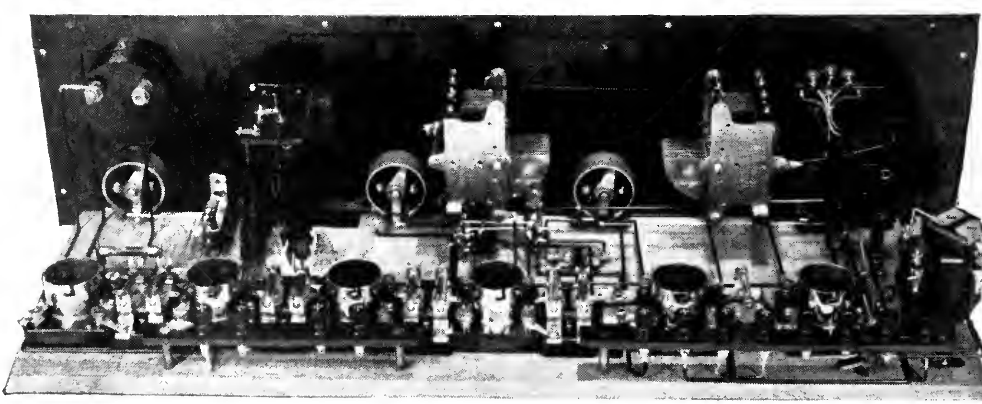


FIG. 6
Rear view showing construction

This resistance is bypassed by a 1 mfd. condenser C. The resistance probably also has a dampening effect on the radio-frequency fluctuations in the plate current, thus reducing feed-back through the capacity of the tube. Because of this, it is not necessary to reduce the plate voltage below the efficient operating potentials of the amplifying tubes in the radio frequency circuit.

A SIX-TUBE ROBERTS RECEIVER

FIGURES 4, 5, and 6 illustrate a special Roberts Knockout receiver built, from data supplied by RADIO BROADCAST, by Schneider and Horneij of New York.

The receiver employs the standard Roberts tuning arrangement followed by four stages of resistance-coupled amplification. The receiver is de luxe in every respect, only a few of the refinements being brought out in the photographs and diagram.

Referring to the diagram, Fig. 4, the apparatus to the left of the dotted line is identical with the usual Roberts equipment. C1 throughout the circuit, is a .012 mfd. fixed condenser. C2 is a 1 mfd. bypass condenser. Filament control jacks were used in the actual receiver, though for simplicity the auxiliary contacts have been omitted from Fig. 4. R1 represents the coupling resistances, having a value of 100,000 ohms. Grid leak, R2 is a 500,000 ohm resistor and R3 a 250,000 ohm resistance. Grid leaks R4 are fifty thousand ohm resistances. R5 has a resistance of five thousand ohms. A meter, reading from zero to fifty milliamperes has been included in the plate lead to the resistance-coupled amplifier.

The following is a list of the exact parts used in the receiver described. Substitution of equally efficient apparatus will not affect operation.

Bakelite Panel 7″ x 27″ x $\frac{3}{16}$″, engraved
2 Cardwell .0005 Condensers.
6 Federal Sockets
Amertran, 5:1 ratio
3 Federal Jacks (using 2 on tubes five and six)
3 Eztoon dials, 4″
Nazeley Coil
4 G. R. Rheostats
G.R. Switch and Points,
Eby Binding Posts
4 Daven Resistor Couplers, Condenser Mountings, Leaks, etc.
Dubilier Condensers, Pacent Balcon and Neutralizing Condenser
Weston 0-50 Milliampere meter in plate circuit of Resistance Amplifier tubes only.

TABLE OF CURRENT CARRYING CAPACITIES OF WIRES USED IN WINDING SMALL TRANSFORMERS

SIZE WIRE (B & S)	SAFE CURRENT WHEN WOUND ON PRIMARY	SECONDARY
10	9.5	8.0
12	6.1	5.0
14	3.6	3.2
16	2.4	2.0
18	1.5	1.3
20	.96	.80
22	.60	.50
24	.37	.32
26	.23	.20
28	.14	.125
30	.095	.070
32	.059	.050
34	.037	.031
35	.023	.019

FIG. 7
These current carrying capacities are for transformer windings, and are considerably less than the safe limit for open wiring

WIRE SIZES AND CURRENT-CARRYING CAPACITY

THE publication IN THE R. B. LAB. for September and October, 1924, of data on the design and construction of small transformers, aroused considerable interest among our readers who are considering the construction of B battery eliminators and battery chargers. In the articles to which we refer, mention was made that the sizes of wires in the primary and secondaries would be governed altogether by the amount of current which they were to handle. For the benefit of our readers who have been puzzled on this point, we publish the table appearing as Fig. 7. Different sizes of wire, from No. 10 to No. 36 B & S gauge (A. W. G.) are given with their corresponding safe current carrying capacities *in transformer windings*. This data is sufficiently accurate and can be used without correction considerations in the construction of small transformers.

For example, we shall assume the experimenter desires to build a transformer operated from a 110 volt source for supplying plate potential to an amplifier. The maximum output will be forty milliamperes at three hundred volts. The secondary must there-

fore be wound with wire that will safely carry this current, and referring to Fig. 7 we find that this is No. 33.

Multiplying the volts, 300, by the amperes, .04, will give you the number of secondary volt-amperes. In a perfect transformer this would be exactly the volts-amperes inputted to the primary. However, efficiency must be considered, and so we multiply this VA rating 12, by 1.2 the product being close to the volts times amperes in the primary circuit. Therefore, primary volts multiplied by primary amperes equals 14.4, or $\frac{14.4}{110}$ is the number of amperes flowing in the primary under full load. The primary current then is .122. Again referring to the table we find that the correct primary wire is about No. 28.

In all cases, of course, a larger size wire may be used for convenience or other reasons.

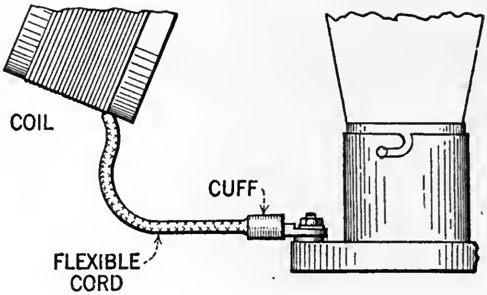


FIG. 9
A half inch of spaghetti keeps the silk from fraying

LABORATORY HINTS

EDISON element storage B batteries can be charged at comparatively high charging rates without harm. Most B battery chargers using electric light bulbs as a series resistance only charge at a rate of about 75 to 100 milliamperes, which is quite correct for the majority of lead plate cells. However, on Edison cells this rate may be considerably increased by the substitution of a soldering iron or an electric iron for the lamp. Fig. 8 shows a commercial type of charger—the "Unitron"—an efficient bulb rectifier for charging both A and B batteries without the purchase of additional apparatus, charging a Todd B battery through a standard 500 watt electric iron. The complete battery is charged as a forty-five volt unit at close to a one-half ampere rate. Three hours running completely charges the battery, and after six months of repeated charging no ill effects of the comparatively high rate can be observed. If anything, the battery is in better condition than when originally obtained.

FIGURE 9 shows a wiring kink that solves in a neat and efficient manner the tendency of flexible cables to fray at the ends. Flexible wires, generally of the ordinary lamp cord type, are indispensable to the wiring of most receivers employing variable coupling, such as the Roberts. Moving coils are connected to the stationary bus-bars by means of these leads. If a small piece—a half inch or so—of spaghetti tubing is slipped over the ends of the flexible cables, forming a "cuff," a permanently neat job is assured.

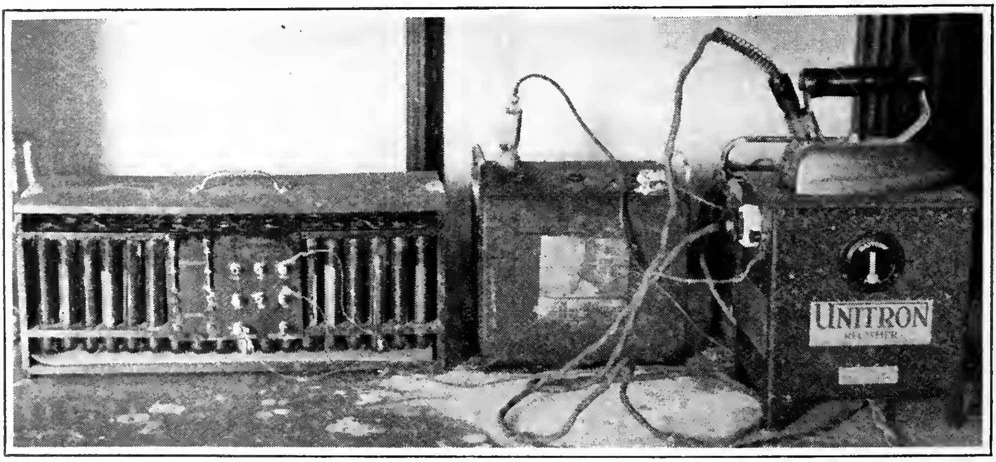


FIG. 8
A flat iron can be substituted for the usual carbon lamp when high charging rates are desired. An electric toaster will pass approximately the same current

How to Build a One-Dial Reflex Receiver

A Sensitive Non-Radiating Receiver Using Crystal Detection and Push-Pull Amplification which is Simple to Build and Operate—The Combination of Crystal and Push-Pull Produces Excellent Quality

By JOHN C. DAVIDSON

THE receiver described in this article may very well be called universal. It is, in effect a one-, two-, or four-tube layout, depending on just how much the builder cares to do at a time. One may start with the single-tube layout and add the remainder at will. The two last tubes are used in a push-pull audio amplifier arrangement and are entirely unnecessary for loud speaker operation on stations up to several hundred miles—at night, of course.

In our tests of this receiver we operated a loud speaker on stations up to 300 miles distant with a single tube, up to 700 miles distant on two tubes, and on stations 1500 miles away with all four tubes. This is not guaranteed operation, but is not highly unusual operation. The selectivity is very good, though it does not equal the two- and four-tube Knockout receivers employing the Roberts circuit. There is but a single major tuning control. The receiver is very easy to build.

We suggest building the two-tube receiver first, because it produces enough volume for most purposes. If after trying two tubes, the music is not loud enough for dancing, the push-pull amplifier may be added.—THE EDITOR.

TWO years study of reflex circuits have brought out a number of interesting points about this popular method of radio reception. It is claimed that a circuit with one tube reflexed through a crystal detector will equal on distance reception, and at the same time give far more volume and better quality than the ordinary one-tube regenerative receiver. This additional energy gain is due to the fact that one tube reflexed, gives a stage of radio-frequency amplification; a certain amount of regeneration, which seems to be inherent in the majority of reflex circuits, and a stage of audio-frequency amplification. At the same time, there is a limit to what can be expected from one tube, and this makes the reflexing of more than one tube a questionable procedure, when using an antenna-ground system.

The circuit described here is a logical development obtained from a study of the above analysis. It comprises one stage of radio-frequency amplification with a stage of audio frequency reflexed through it, a fixed crystal detector, a second stage of audio-frequency amplification and finally a stage of push-pull audio-frequency amplification. This combination gives plenty of loud speaker volume with local reception and good loud speaker volume for reception up to 1000 miles, it being understood that long range work is subject to seasonal and atmospheric conditions. At the same time, particular attention has been paid to selectivity, so that at least six or more distant stations can be brought in through the locals of the large cities. This performance is especially noteworthy in view of the fact that it is obtained with a single tuning dial and one volume control dial, which makes the operation about as simple as can be desired. Stations heard can be logged and returned to on their own dial setting.

THE CIRCUIT

THE circuit in principle can be best understood by referring to Fig. 1. Part of the radio-frequency tuning coil secondary is contained in the first grid circuit and the remainder of this coil is used in conjunction with the small balancing condenser "CB" to stabilize the circuit, and control the volume. It is the experience of the writer that the first audio

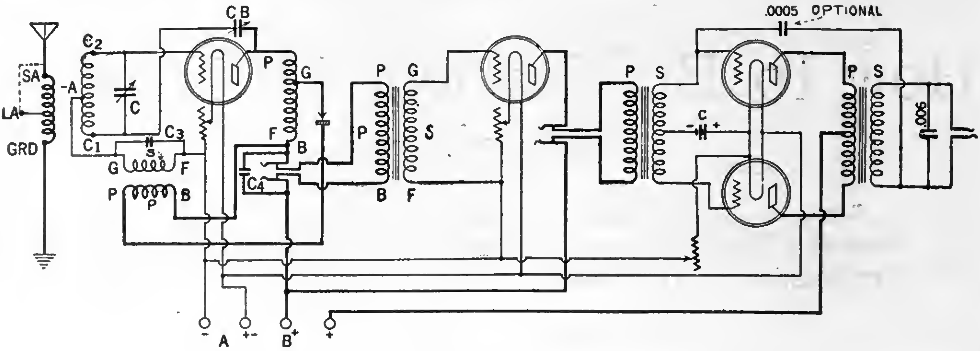


FIG. I

The schematic circuit of the reflex receiver. The peculiar connection to the grid and plate circuits are especially to be noted. The constructional details are contained in the accompanying article. The radio-frequency transformer, shown in the diagram is completely illustrated in Fig. 3

transformer should have a ratio of the order of 10:1 to work best with the crystal. A small fixed condenser, "C3" should be placed across the secondary of this transformer to bypass the radio-frequency currents. Its capacity should be .00025 or .0005 mfd. The condenser "C4" is fixed, and may be as large as .005 mfd., and is placed across the two outside terminals of the double circuit jack, as a further by-pass. The second audio transformer should be of about 4:1 ratio for good quality.

The tuning unit used here is the result of considerable experimental work. It has a low distributed capacity and at the same time the three coils have a high degree of coupling.

In designing this unit the following conditions had to be met. The circuit must be able to oscillate over the entire range of broadcast wavelengths, with a fixed winding radio-frequency transformer in the plate circuit of the tube. By means of the balancing condenser and part of the secondary coil, these oscillations must be balanced out. At the same time, a high degree of selectivity must be maintained.

The tuning coil is of the fixed coupler type with an untuned primary and a tuned secondary. The primary has one tap to be used with a long antenna. The tuned secondary has a tap so placed that one part of the coil is included in the grid circuit, while the other part acts as a balancing-out or compensating coil. When used in conjunction with the balancing condenser "CB", all regeneration can be controlled.

The coil winding data for the tuning unit is outlined below:

Size of Tubing:—2″ long x 1¾″ diameter.
Coil No. 1 consists of 21 turns tapped at the 16th. Inside turn connects to grid 16th to LA and 21 st to SA.
Coil No. 2, 35 turns, outside lead to C2, inside lead to —A.
Coil No. 3, 25 turns, outside to —A, inside to C1.
All the coils are wound with No. 26 d. s. c. wire on a form slightly greater in diameter than the tubing. The form has 19 spokes ⅛″ in diameter producing a coil about $\frac{3}{16}$″ wide. The winding style is over two and under two spokes.

BALANCING CONDENSER

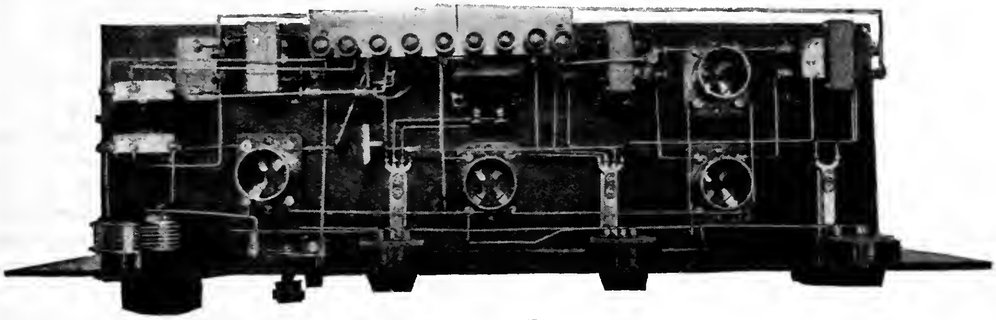
A PHOTOGRAPH of the balancing condenser is shown. It will be noted that this condenser is designed to have an extremely small minimum capacity. Unless this minimum capacity is very small, the circuit will be sensitive only over the middle portion of the broadcast wavelengths.

The small commercial condensers available were found to be unsuitable for this purpose, so that a special condenser had to be designed. Those who desire to make their own can do so with old parts on hand. The only conditions to be met are a low minimum capacity and a maximum capacity of about fifty micro-microfarads. "C" is a variable condenser whose capacity may be as low as .00029 mfd. and should be of fairly good design. This capacity is equivalent to 13 to 17 plates depending upon the make of the condenser.

THE DETECTOR

A FIXED crystal is used for the detector. Right here it may be advisable to point out a great weakness of the variable crystal detector.

A given setting of the detector introduces a certain resistance into the circuit. If the circuit is tuned and adjusted to a certain wavelength and the variable detector is then



INSIDE

The "works." As can be seen, the wiring for this receiver is not difficult and the layout parts quite easy to duplicate

reset, a different resistance will be introduced necessitating a retuning of the entire circuit. This is particularly annoying if the station that is being received is a distant one. This difficulty is entirely eliminated when a fixed type of crystal detector is used.

THE RADIO-FREQUENCY TRANSFORMER

REFERRING to Fig. 1 once more it will be noted that the radio-frequency transformer used, is of unique design and is especially built to give maximum amplification over the broadcasting wavelengths when used between a tube and a crystal detector. It has a step down ratio and will not function between two tubes as is the case with the ordinary radio-frequency transformer.

Its construction is as follows:——

On a spool $1\frac{3}{4}''$ in diameter and $\frac{5}{8}''$ wide, having a slot $\frac{1}{8}''$ wide and $\frac{1}{2}''$ deep are wound 170 turns of No. 35 wire.

First, 70 turns are wound in the slot and a tap taken off which connects to G, then 100 turns are wound over this, the end connecting to P.

The beginning of the winding connects to F and B. See Figs. 1 & 3.

WIRING THE SET

FIGURE 2 is a picture drawing of the exact layout of the interior of the set and shows each piece of apparatus in relation to the other parts. It also clearly indicates the wiring. The panel size is 7 x 24″ and is drilled according to the layout in Fig. 4. There are ten terminals at the back of the cabinet. Reading from left to right they are LA, SA, GND, —A, +A, —B, +B, +B, C+, C—. These terminals should be mounted on a bakelite strip and so supported that the terminals do not come in contact with the wood.

For the sake of simplicity, the wiring will be divided into four stages, namely, the filament wiring, the antenna-grid wiring, the reflex wiring and the audio-frequency wiring.

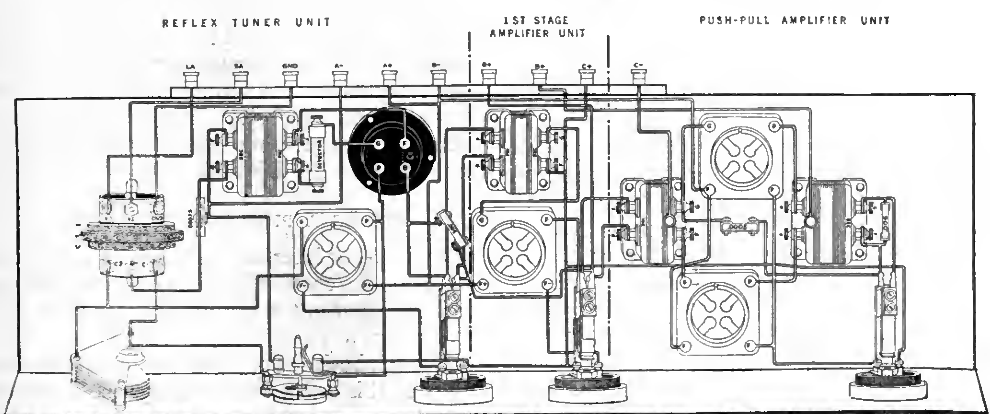


FIG. 2

A picture layout of the complete receiver

From the binding post marked "+A" run a wire to each socket terminal marked "+F". From the binding post marked "—A" run a wire to one terminal of the filament switch. From the other switch terminal run a wire to one terminal of each rheostat. The other three terminals of the rheostats are connected respectively to each socket terminal marked "—F". The filament circuit is now completed. As each wire is put in place it is well to mark it off on the circuit diagram with a red or blue pencil.

The antenna-grid circuit is wired as follows: Run a wire from the tuner terminal marked

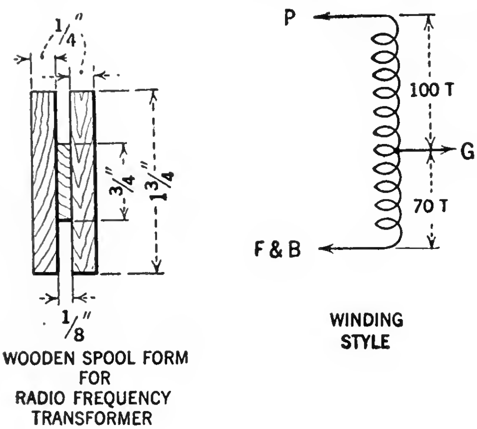


FIG. 3

Constructional and winding details o. the special radio-frequency transformer

"LA" to the left hand binding post which should also be marked "LA" (long antenna.) Run a wire from the terminal "SA" to the binding post to the right of the one marked "LA." This binding post should be marked "SA" (short antenna.) Then connect the terminal marked "GND" to the binding post to the right of the one marked "SA." This binding post should be marked "GND" (ground). This completes the antenna-ground connections. The grid circuit is wired as follows. Connect the tuner terminal "C2" to the stationary plates of your thirteen or seventeen plate condenser, and connect the terminal "C1" to the rotor plates. Then run a wire from "C2" terminal to the first socket terminal marked "G". Connect the tuner terminal marked "—A" to the secondary terminal of the high ratio audio transformer marked "G." The "F" terminal of this transformer secondary is joined to the wire from the "—A" binding post. A small fixed mica condenser (.00025 or .0005 mfd.) should be connected across the secondary terminals of this audio transformer. There remains only the compensating condenser, the rotating plate of which is connected to the first socket terminal marked "P" while the stationary plate is connected to the tuner terminal "C1". This completes the grid circuit.

All these connections are clearly shown in Fig. 2 together with the general shape of the wires, and by following the drawing the problem becomes fairly simple.

The reflex circuit is wired as follows. Connect the first socket terminal marked "P" to the "P" terminal of the radio-frequency transformer. The "B" terminal of this transformer is connected to the upper terminal of the double circuit jack. The bottom terminal of the double circuit jack goes to the binding post at the extreme right and should be marked "+B". A fixed mica condenser C4 of .005 mfd. capacity should be connected across the two outside terminals of the double circuit jack. From the "G" terminal of the radio-frequency transformer, run a wire to one end of the fixed detector. The other terminal of the fixed detector is connected to the primary terminal of the high ratio audio transformer marked "P." The "B" terminal of this audio transformer is connected to the "F" terminal of the radio-frequency transformer. The reflex circuit is now completed,

From the double circuit jack terminal next to the top, run a wire to the low ratio audio transformer terminal marked "P." The remaining double jack terminal is connected to the "B" terminal of the low ratio transformer. Join the "G" terminal of this transformer to the second socket "G" terminal and connect the "F" terminal of the transformer to the wire coming from the "—A" binding post. Connect the "P" socket terminal to the *bottom* terminal of the next double circuit jack. The top terminal of the second jack goes to the "+B" binding post. The wiring is completed by connecting together the binding posts marked "—B" and "+A."

ADDING A PUSH-PULL AMPLIFIER

SOONER or later, into the life of every real radio fan comes the desire for more volume and then comes the hunt for a means of amplification.

Though both the one-tube and the two-tube units of this reflex circuit afford good volume on all average reception, there are many who want more. But how to get this additional volume has been more of a problem than would at first glance appear.

FRONT VIEW OF THE PANEL

With the one-tube reflex unit, the problem can be solved by the addition of another tube as an audio-frequency amplifier. It has proved highly impractical to add another audio-frequency tube to the two-tube circuit. One transformer and one tube alone have been unable to handle the output of the preceding two tubes without much distortion. So push-pull amplification has been a life saver—or shall we call it a volume saver?

Push-pull amplification is a necessity when additional volume is desired.

The "how and why" behind push-pull amplification is not half as intricate as some people seem to believe. It differs from the usual straight audio, at first glance, in that two transformers and two tubes are used for each stage. The first transformer is the coupling transformer which divides the output of the preceeding tube evenly between the grids of the two push-pull tubes. The second transformer collects the outputs of the two push-pull tubes and passes the total energy on to the loud speaker.

The term "push-pull" is used because the grids of the two tubes in each stage of push-pull amplification are charged with opposite polarity at any instant. While one grid is positive, the other is negative. Any tendency to distort in one tube is counteracted by the other tube.

The first transformer performs the double duty of dividing the input current between the two tubes and of delivering it to these tubes in such a manner that the two grids will be oppositely charged. It does this by means of a split winding. While the primary winding is one continuous winding coming out to two binding posts in the usual manner, the secondary is tapped at its central point and is therefore brought to three binding posts. The binding post leading to the center tap is connected to the negative A battery through the C battery. The other two binding posts are attached to the grids of the two tubes.

Conversely, the second or output transformer of the push-pull stage of amplification has a tapped primary and a conventional secondary. In this transformer the primary winding is brought to three binding posts and the secondary winding to two. In this case the central primary tap is connected to the B battery while the other two posts are connected one to each plate. The two posts of the secondary are connected to the speaker just as the two posts of the first transformer were connected to the plate and B battery of the last audio-frequency tube.

THE LAYOUT OF THE AMPLIFIER

THE layout of the push-pull unit can be made rather flexible. If space permits, the two tubes can be placed one in front of the other. The two transformers should be put one on each side of the tubes. This makes the wiring short and direct. It also reduces the

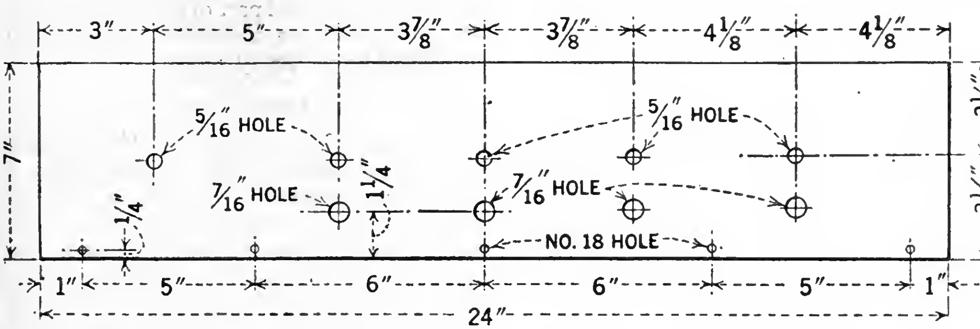


FIG. 4

The panel layout. The photograph above shows the appearance of the finished panel

chance of error, since the transformer and tubes, when in this position, almost connect themselves because of the proximity of binding posts to binding posts.

The two input or primary terminals of the first transformer are connected to the two central prongs of the center jack in the set. The outside terminals of the secondary are then connected to the grids of the two tubes, each to the nearer grid. The central terminal is run directly to the negative post of the C battery, while the positive post of the C battery is run to the negative A battery binding post.

The filament connections are made in the usual way, the two filaments being placed in parallel and being controlled by the one rheostat. The plate of one tube is connected to one of the two outside posts of the primary of the second transformer, the plate of the other tube to the other. The central binding post of the secondary is attached to the plus post of the high B battery voltage. The two secondary leads from the second or output transformer are wired to the push-pull jack. A .0005 mfd. fixed condenser C5 is connected from the upper grid side of the secondary of the input transformer to the lower side of the secondary of the output transformer as an additional stabilizing capacity. Various values of capacity may have to be substituted to obtain quiet operation.

In some cases it may be necessary to include in the push-pull amplifier circuit the .0005 mfd. fixed condenser shown connected between the G terminal of the secondary of the input transformer and the F terminal of the secondary of the output transformer. Usually its addition to the circuit will eliminate any tendency of the tubes to overload and the shunting of the .006 mfd. condenser across the secondary terminals of the output transformer will clarify the tone output of the receiver. This latter addition largely depends upon the type of loud speaker used.

PUSH-PULL AND THE LOUDSPEAKER

MOST loud speakers have an impedance out of all proportion to the impedance of the tube preceding. And yet theory has it that the best results are obtained when the impedance of the speaker or other "load" matches the tube impedance. The push-pull system corrects, or rather, overcomes this because the output transformer separates the loud speaker from the tube circuit.

The ordinary straight audio system places the loudspeaker directly in the plate circuit of the last tube and consequently subjects it continually to the full plate voltage. This means that there is a constant drag on the diaphragm of the speaker which prevents that diaphragm from responding freely to weak or complicated tones.

In the push-pull system, the full plate voltage gets no farther than the primary of the second transformer. It cannot be transferred to the secondary or loud speaker circuit because it is a direct current. Direct currents do not affect a transformer. Only when there is a current fluctuation does the loud speaker winding get an impulse, because only then is the current transferred from primary to secondary by means of induction. It will be seen at a glance that this is the ideal condition. Unless speech or music is coming through the amplifier, the loud speaker has absolutely no potential applied to it, yet when broadcasts are being amplified, the loud speaker winding gets a powerful impulse exactly in accordance with the matter being broadcast.

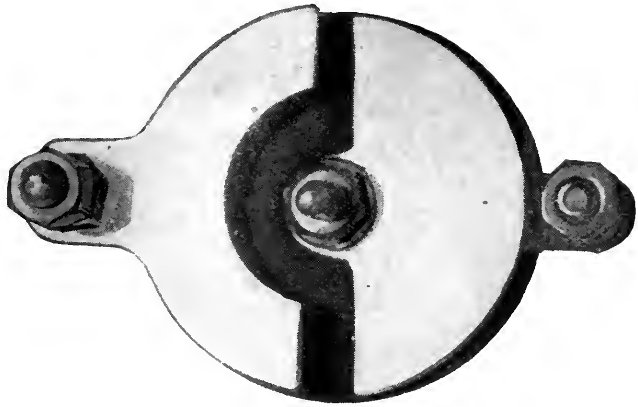
SELECTIVITY

THE circuit described is extremely selective in spite of the fact it has but one tuning dial. Frequently on demonstration, seven or more out of town stations have been brought in on the speaker through the powerful New York local stations.

Referring to Fig. 2, it will be noted that there are three terminals on the primary side of the tuning unit, which are marked "SA", "LA", and "GND". The terminals "SA" and "GND" include the entire winding and should be used with a short antenna of from 40 to 100 feet. The terminals "LA" and "GND" include the larger part of the coil and should be used with a long antenna. If extreme selectivity is desired the antenna may be connected to "LA" and the ground to "SA." This uses only a small part of the coil and while the volume will be somewhat reduced, the tuning will be extremely sharp.

OPERATION

THIS receiver performs best with C-301-A DV-2 or UV-201-A tubes operating from a small six volt storage battery and 90 volts of B battery. At the same time good results may be obtained using a 201-A tube in the first stage and a UV-199 type tube in the second stage, running the two tubes from six volts of dry battery. If this latter method is used, the 30 ohm rheostat controlling the UV-199 type tube must be turned on only just



THE BALANCING CONDENSER

When fully opened as shown has a minimum capacity reading. The distance between the edges of the two plates is $\frac{1}{8}$ inch. The semi-circular movable plate and the narrow $\frac{1}{2}$ inch wide plates make up the full circular form $1\frac{3}{4}$ inch in diameter. The fixed plates are spaced $\frac{1}{8}$ inch apart and one semi-circular plate rotates between them. The plates are mounted on a bakelite base by means of bolts, spacers, and a shaft of the required thickness. All these parts may be secured from a radio shop with average stock

enough to light the filament or the tube will be burned out.

A negative C battery is used to cut down the B battery consumption and to improve the quality of signals through preventing distortion.

To operate at its best efficiency, the set should oscillate or be very near the oscillating point over the entire range of broadcasting wavelengths, when the balancing condenser is at its minimum. At this point the dial controlling this condenser should read 100 degrees. When this dial reads near zero, oscillations should not occur at any wavelength.

TUNING

THE method of tuning this set is very simple and can be mastered in a few minutes. It will be observed that the large dial at the left is labelled "Tuning." The next dial to the right is labelled "Volume." To the right of the dial controlling volume are three rheostat knobs, which control the current in the filaments of the first, second, third, and fourth tubes. Immediately below the volume control dial is the filament current control switch. Continuing to the right of this switch and below the first rheostat knob is a jack for use of phones with only one stage of amplification. Then there is a second jack for the speaker, using both stages of amplification and the last jack employs all four tubes.

At first it will probably be best to try to tune the set with powerful near-by stations. To do this you set the volume control dial near zero and slowly rotate the tuning dial. Then having picked up a local station, by increasing the reading of the volume control dial, the signal should come in loud and clear. The setting of the tuning dial should be recorded and thereafter that particular station should always be found at that setting.

To obtain maximum volume on distant station reception the procedure is slightly different. In this case it is best to set the tuning dial approximately at the desired wavelength and for each of these settings increase the volume control dial until you get a hissing noise. If you go beyond this point you will get an audio note and the volume dial setting should be reduced. Generally speaking, for every setting of the tuning dial get the maximum setting of the volume dial.

The rheostats should be adjusted on a moderate signal until maximum volume is obtained. At the same time, for the sake of economy the tubes should be run no brighter than is necessary to give satisfactory performance.

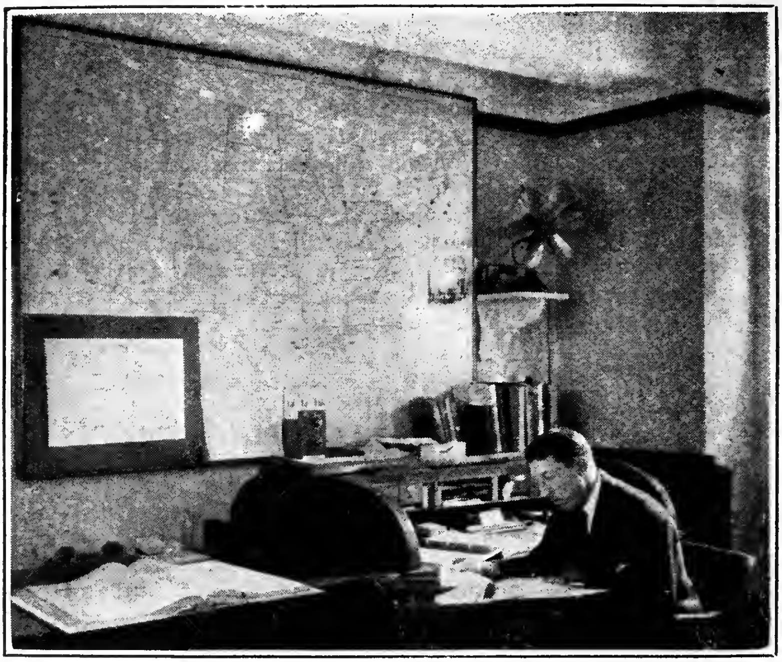
The following is the list of parts for the four-tube circuit.

It is entirely possible to use any standard type of condenser, tube socket, jack, rheostat, etc., when building this receiver, and for that reason, no especial make has been listed. However, for the tuner and radio-frequency transformer units, it is well to use the same parts as specified in the article and used in the construction of the receiver described. If the reader wants to construct his own components, he can readily do so if he follows the constructional data given.

From the data given about the radio-frequency coil, it will be observed that this is no ordinary radio-frequency transformer, such as is used for the common radio-frequency amplifier, but must be especially constructed and connected in the circuit as shown in Figs. 1 and 3.—THE EDITOR.

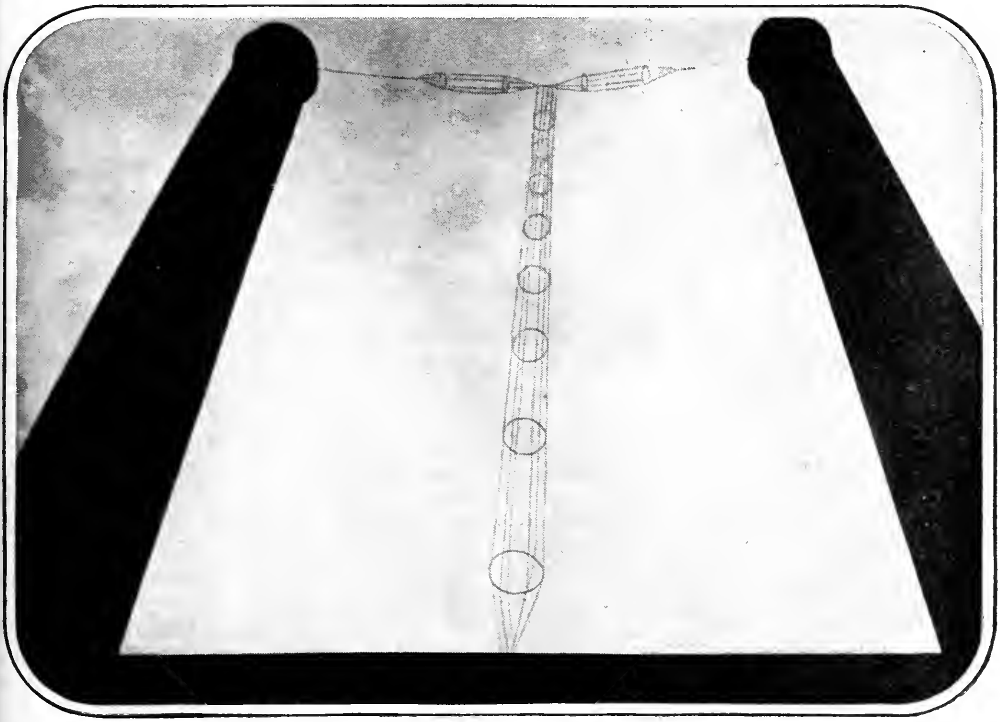
LIST OF PARTS

1 Cabinet 7" x 24"
1 Panel 7" x 24"
1 Rasla Radio-Frequency Tuner—May be purchased, or home-made as described.
1 Variable Condenser .00029 mfd. (minimum cap).
1 Rasla Radio-Frequency Transformer—May be purchased or home-made as described.
1 Fixed Crystal Detector
1 Modern 10-1 Audio Transformer
1 Modern Low Ratio Audio Transformer
1 Rasla Balancing Condenser—May be purchased or home-made as illustrated.
1 Filament Control Switch
4 Sockets
2 16-Ohm Rheostats
2 Double Circuit Jacks
1 Single Circuit Jack
1 Dial—vernier type preferable
9 Binding Posts
1 C Battery
1 Modern Push-pull transformer No. 112
1 " " " No. 113
(Other makes may be successfully employed)
1 Fixed Mica Condenser .0005 mfd. capacity
1 Fixed Mica Condenser .006 mfd. capacity.
1 Fixed Mica Condenser .005 mfd. capacity
1 Fixed Mica Condenser .00025 mfd. capacity



J. C. GILBERT

Who is in charge of the Department of Agriculture radio market news broadcasting system. The map on the wall shows the location of the broadcasting stations which the Department uses for this service



THE ANTENNA AT STATION 5IT, BIRMINGHAM

What We Are Doing With Broadcasting

The Chief Engineer of the British Broadcasting Company Compares English and American Broadcasting

By CAPTAIN P. P. ECKERSLEY

Chief Engineer, British Broadcasting Company

I THINK we will all agree as broadcasters that it is certainly more blessed to send than to receive. But at this particular moment I do not know that I can agree with that sentiment either, because it is very difficult in a short time to give you an adequate picture of what we are doing on the other side. May I say that in trying to paint this picture I am only doing it with the idea of not vaunting it as the most wonderful thing that has ever happened, nor decrying it as the most miserable. But to show you how broadcasting has been misunderstood when comparisons between national systems have been undertaken, I may state that I have read in some of your newspapers occasionally severe criticisms of your own progress and of ours; and I have seen foolish comparisons between the two. There can be no comparison at all, where the differences of areas are something like six million square miles as compared with a few hundred, and where there is a different temperament of the people to be considered, and different conditions in every sort of way.

In the first place, we were miles behind you. You started broadcasting long before we did. But the amateurs of England petitioned the then Postmaster General two years ago that

they should have some station which should transmit to them regularly. More than forty thousand people petitioned. Well, the Postmaster General graciously permitted that such a station should be erected and operated for a quarter of an hour once a week! Strangely enough, I was put in charge of this colossal undertaking, and broadcasting in England started in that way, in the year 1922. During that year we broadcast for a quarter of an hour a week, using Victrola records, and so on; while the transmissions, which were later treated in a less serious manner, because I was in charge of them, might have raised the enthusiasm of the amateur to a fever pitch they did not quite fulfill the more cultivated tastes of the high-brows of the radio profession, and as far back as that year, 1922, people began to realize that something must be done in England to put broadcasting on a firm basis. What they did was to have a conference which lasted exactly six months; and they finally came to a decision which was really a rather wise one, considering the nature of the problem.

Where the Crystal Set Rules the Radio Waves

Britannia may rule the waves if one believe the anthem, but in English radio, it is the modest crystal set which marshals the radio wavelengths. The United States led the world in broadcasting, but England was really the second nation to follow. It is especially interesting to see along what lines British broadcasting has developed, because the two nations have a common bond of culture. Their method of payment for broadcasting is totally different from the American. And from some of the things Captain Eckersley says, in his decidedly humorous fashion, the English listener is quite different from our listener who uses "tubes" instead of "valves." This story is taken from an address made by Captain Eckersley at the Department of Commerce Radio Conference in Washington, early last October.—The Editor.

EVERYONE IN ENGLAND WANTED TO BROADCAST

THEY said they all wanted to broadcast. The first idea was each one wanted to broadcast—newspapers, etc., and twenty-five applications came in to broadcast in London alone; and it was felt that would not work. So finally the scheme arrived at was that the six big manufacturers we have over there, who are called "the big six," all came together and said, "We will put ten thousand pounds into the capitalization of the company, and this company will be responsible for nothing but the broadcasting. It will not be a profit-making concern in any sense whatsoever. It is simply and solely to send out the best programs possible." They put in that money and they said, "If this thing makes a profit, we will limit our profit to seven and one-half per cent. on our original investment. Nobody can take any shares in the company unless he is a bona fide British manufacturer." Then, of course, the question was—The capital was sixty thousand pounds to start. Where would the revenue come from? The idea was that every person who made, bought, borrowed, stole, or otherwise got a receiver, would take out a license, because it was the rule of the country that he had to take out a license. And of course everyone obeyed the law. In this law-abiding nation you all know about that! This license would cost ten shillings, of which the Government would have five shillings, and the company five shillings. And so we should have our revenue.

I will not tell of our various vicissitudes, or the troubles that resulted, or of the few licenses taken out, first of all, and the total inadequacy of the service, according to the press. At any rate, at the present day the scheme has worked out very well. The first achievement was, we got 7/6 (about $1.75) from the Government, and they only took 2/6 (about $.60) The second achievement was that the original rather hide-bound regulations were done away with, and one uniform license was issued, of which we got 7/6. In 1922 there were ten thousand licenses. When I left England we were getting up a special program to commemorate the buying of the millionth license. So the progress has been extraordinary, and our income about two million dollars a year. At any rate, we are spending every penny on the service, and we hope that, being able to spend all that money on the service, the programs can be made excellent, because you can afford to buy the very best talent, and you can afford to pay people just as if they were performing on a concert platform, and you are also able with this money to put up a fine technical scheme, having regard for the English temperament.

THE TECHNICAL EQUIPMENT

WE ERECTED eight main stations of the same power as your WEAF., etc., in New York. We had one and one-half kilowatts. These stations were erected, and dotted over England, to try to get uniform distribution throughout zones, just as you are doing.

Now the Englishman is a peculiar person, and having once got this scheme going, he does not keep on living seventy or eighty miles away from the station, and getting more and more distance. He does not care to reach out—I think you call it, nor has he the ambition of the man to reach Australia on half a valve. He is far more keen to get a pure, undisturbed signal, and he only hears the one single one coming from his local station. And our ambition is that any man in England can listen in on an apparatus made up of a clothes-line or a piece of string, and really hear his program uninterruptedly. And that is the way we have worked it out. The one ambition I have had is to give everybody so good a signal that they can not complain of the engineering side of it, but always must complain of the programs. I am not an engineer! Well, that ideal was not realized by the erection of the one and one-half kilowatt stations, because outside, thirty miles from that place, the service is not what we consider perfect, because it is liable to interruption. You know, in England we are all packed together, and there is a great deal of shipping, and they have not the wavelength allocations you have.

A Frenchman fishing off our coast will signal back and forth with his nearest home station about how many fish he has caught, and every time he tells about it, the while the fish constantly growing longer, he requires a longer message to narrate the thing. And so we must create much stronger signals perhaps than you have to use here. There were large areas in densely populated places where people could not receive; so we erected a royal station, designed to serve only the town or city in which it was located. We put these stations down, and it would be too expensive to provide programs every day up to the excellence of the programs we do provide in the large stations, so we linked these up by ordinary wire to our London program. But here is the difference in England: As technical men, responsible for the technique of our own station, we are not, of course, responsible for those trunk lines outside. I put a signal on the wire, and the Government does the rest, and it sometimes arrives at the other end. As a matter of fact, the service, considering it has grown up in the way it has, is an extraordinarily good one.

Another function of the royal station is that you are able to give a local program from that station. Every city, of course, thinks it is just a little bit better than the next one, and if they can talk about it on their radio, it pleases them. So we give these stations over to local civic functions, etc. In Sheffield, they give the annual talk of the master of that city, or in Liverpool someone speaks treating of cotton prices, etc., all the things that appertain to the locality. They use that station to create local interest, whereas if there had been some impersonal, large, high-powered station, it would have bored Liverpool, for instance, horribly, to have to listen to the superlative merits of Glasgow or Manchester! So then we had the royal stations and main stations, and with that establishment, I estimate that, taking crystal reception as a basis, out of the forty-three million people we serve, exactly fifty per cent. could get a

TIME SIGNALS FROM "BIG BEN"

Are frequently broadcast from 2 LO, at London. The photograph shows engineers for the company with a portable microphone, pulling in the sound. At the start and conclusion of some of the international broadcasting in November, time signals from this clock were sent out

signal on an ordinary simple crystal set; and they do. They use the crystal set to a man. You would be amazed to see the extent to which this simple set is used. I should think that the crystal set represents forty-eight per cent. of the fifty per cent. mentioned. Nearly everybody has a crystal set. They love it. They put it in the corner, and sit all night listening.

DEMOCRATIC BROADCASTING

BUT still feeling that broadcasting should be democratic so that anybody, anywhere, with anything to listen on, could get it, we came to the conclusion there were still large areas unserved by main or royal stations. We have just secured permission to erect a super-power station, to reach all areas not previously served by main or royal stations. This station, which has been running experimentally in England for the last three months, is a station of twenty-five kilowatts power, about twenty-two kilowatts in the antenna, at least so the designers told me. This station has a crystal range of exactly one hundred miles. It works on a wavelength of sixteen hundred meters, which was wrested from the Government under great pressure. We have found out the value of the longer wavelength in that you suffer neither from fading, night distortion, or jamming. The station does not send out stuff banked up in the middle and falling off at the ends, and at the long distances, four and five hundred miles, the station is very adequate. I listened myself in Scotland, and with a single valve reaction I was able to hear that station every night clearly. The only trouble was static. And there's another slight trouble, and that is with the strength falling off slightly at night. But on the whole that station is very successful. And down along the coast we feel that we have solved our problem once for all, and everybody, everywhere is given a strong, adequate signal.

You may ask about the variety in the program. The variety is in the program. We block the program out to cater from the meanest intelligence up to the highest high-brow. We vary our selections from the more humble *Rhapsodie Hongroise* of Liszt up to the classical *Yes, We Have No Bananas*! We have tried to keep the *Yes, We Have No Bananas* side of the thing down just a bit, however, and our great criticism is that we are sending much too highbrow programs. Well, as a matter of fact, it is a subtle compliment to pay to anybody to give him something rather above him, and we have found it immensely successful.

SEVENTY PER CENT. USE CRYSTALS

WITH the high-power station, we may say that seventy per cent. of the population of Great Britain is served by crystal; and while the manufacturers may not be quite so pleased about it, at any rate the people whom we are serving are, and we feel that the manufacturer has got a great field, because he will be able to concentrate on the one thing that needs concentration, that is, the perfect quality, the perfect transmitting of sound between the studio and the drawing room or kitchen. That is what we are working on, not to listen to the distant signal, but more to get perfect programs, perfectly reproduced. And that is more or less the line that we are working on at the present time. We have a different problem, a different temperament, but that is what we are doing.

I should like to say a word on the linking up of the two continents. We did last year, as you know, broadcast probably more than

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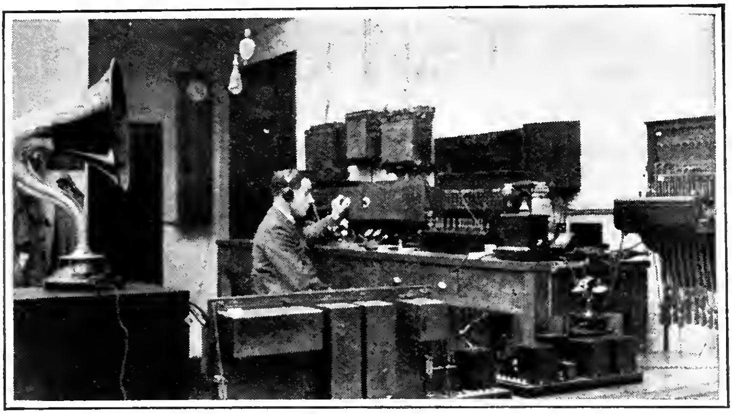
LADY TERRINGTON

M. P. for Wycombe, Buckinghamshire, listening to a British Broadcasting Company program

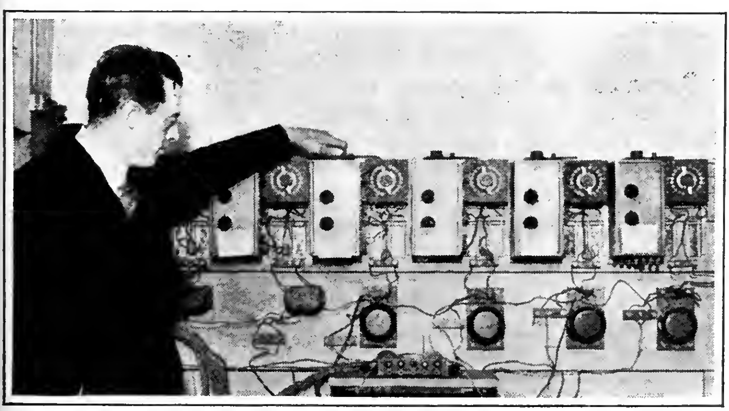
any other organization has ever done in the world. We were trying to receive signals from America! We tried to pick up the various hundred meter stations, and occasionally a reply did come through, and occasionally we did have a sort of guessing competition as to whether it was a brass band or a piano. We did broadcast this, and it made a tremendous sensation in England; and on one particular and historic occasion signals from East Pittsburgh were received in England rebroadcast, and sent to South Africa, a distance of nine thousand miles! We do feel that the future of broadcasting must be intimately connected with the strengthening of friendly relations between the continents thus bound together by sound. And what could be more ideal than that America and England should be linked together by this mighty force, inasmuch as they are both English-speaking people, and they will probably, after a little practice, be able to understand one another.



THE CONTROL ROOM OF THE BELFAST STATION

Call letters 2 BE, one of the newest of the British Broadcasting Company chain

There is no doubt, however, in the minds of engineers that there is only one thing to do if we are to link up the two countries, and that is purely on the engineering side. It's an amazingly long way across the Atlantic. I have just crossed it. And it seems to me that to make that journey in $\frac{86}{1000}$ part of a second will take a great deal of push behind the traveler. And one thing we must concentrate on is the question of having high-power stations to link up the two continents. Of that there can be no possible doubt. We are absolutely ignorant of transmissions at long distances at night. But it seems to me that inasmuch as the amateurs of both countries have spoken to each other with about two watts, by c. w., as reported in our press, we feel that we can deal with 150 up to 200 watts, and it might be possible to get communication between the two countries; and if we did, it would stimulate a great interest on both sides of the water. If we could be certain on occasion of hearing some of your most interesting pronouncements, and you could listen to us drawling away, we would find that radio really had tremendous possibilities for good, and it would tend toward our understanding each other a little better than we sometimes do. And I think that, with the English-speaking people, at any rate, radio has a great future. It must be so.



CAPTAIN ECKERSLEY

Chief Engineer of the British Broadcasting Company, at the relay apparatus in the London headquarters. Programs are frequently given in the London studio and relayed by wire to the other stations in the chain. The purpose of this is to allow the owner of a crystal receiver to hear strong signals from London. The apparatus in the photograph is necessary to "boost" the signal strength to overcome the resistance in the wire lines connecting the stations

The Decision in the "Who is to Pay for Broadcasting?" Contest

A Prize of $500 Was Awarded to H. D. Kellogg, Jr., of Haverford, Pa.

FOR three months since the close of the contest "Who Is to Pay for Broadcasting?" the judges have been going over the great number of manuscripts submitted for the prize. Suggestions there were of all kinds, and the problem of deciding which one of all the group was the best was not found at all easy. The judges were carefully chosen to represent all branches of thought which could possibly be concerned with the broadcasting problem. They were, Professor J. H. Morecroft, president of the Institute of Radio Engineers (1923-4); Major J. Andrew White, former editor of the *Wireless Age* and well-known descriptive broadcaster; Harry Chandler, publisher of the Los Angeles *Times* and owner of KHJ; Frank Reichmann, a Chicago radio manufacturer and an old-timer in the field; Dr. Royal S. Copeland, United States Senator from New York, representing the public point of view; A. S. Lindstrom, chairman of the Pacific Radio Trade Association; Zeh Bouck, one of the best known radio authors in America; and Charles H. Porter, Chicago, secretary of the Radio Manufacturers' Association.

In the May, 1924, RADIO BROADCAST, the purpose and rules of the contest were announced. It was then said that "a workable plan which shall take into account the problems in present radio broadcasting and propose a solution" was desired. A plan was wanted which should propose a practicable and workable solution of the present complex radio situation. Very nearly one thousand manuscripts were submitted to the judges.

The complete prize-winning plan will appear in the March RADIO BROADCAST. In brief, it calls for the public to shoulder the cost of broadcasting by means of a stamp tax on each vacuum tube and crystal bought by the consumer for his radio set. Radio broadcasting, avers the author of the plan, should be placed on a sound economic basis and to be so, should pay its way, precisely as other forms of entertainment. In order that radio secure the best possible available entertainment, broadcasting should be put on a paid contract basis. Tubes have a life commensurate with the service they render, the prize-winner claims, which makes them an "index of broadcast consumption." The number of tubes was considered to be an excellent index of the cost of the set and the distance over which it would receive. It was finally proposed that a newly created Bureau of Broadcasting administer the fund to be collected from this tax. Stamps purchased by the tube manufacturers from the Bureau of Broadcasting would be affixed by the manufacturer of the tubes, and the amount of tax to be paid would be determined from statistics compiled by the Bureau.

Neither the American Radio Association, under whose auspices the contest was conducted, nor RADIO BROADCAST which offered the $500 as a prize necessarily concur in the suggestions offered by the winner, Mr. H. D. Kellogg, Jr., of Haverford, Pennsylvania.

Later numbers of this magazine will contain some interesting comments on this entire question of who is to pay for broadcasting.

A Winder for Small Inductances

How to Build and Use a Device to Wind Efficient, Concentrated Inductances Which May be Used in Various Radio Receivers—How to Wind the Coils for the Radio Broadcast Six-Tube Second Harmonic Super-heterodyne

By ALLAN T. HANSCOM

MANY readers have been greatly interested in the second harmonic super-heterodyne described in Radio Broadcast for November, 1924. One of the central features of that six-tube receiver is the concentrated inductances. These are wound by a special machine which is described here. The construction of this device is not especially easy and had best be assumed by those readers who are adept at using a lathe and similar tools. In addition to the method of assembling the winder, complete information is given on the number of turns and dimensions for the intermediate frequency and oscillator coils for the six-tube, second harmonic super-heterodyne.—The Editor.

SO MANY requests have come to the writer for constructional data on the small honeycomb coils which are used in the six-tube super-heterodyne discribed in this magazine for November, 1924, that a description of the method by which these coils are made should prove interesting.

In the first place, some of the more important requirements for any inductance to be used in radio work should be considered.

LOW DISTRIBUTED CAPACITY

DISTRIBUTED capacity in an inductance greatly increases the resistance of the inductance at the higher frequencies. The direct current resistance of an inductance is an inverse function of the wire size. By this we mean that the resistance of a coil of coarse wire is less than a similar coil of fine wire, but with coarse wire the distributed capacity in-

FIG. 1
A photograph of the completed coil winder

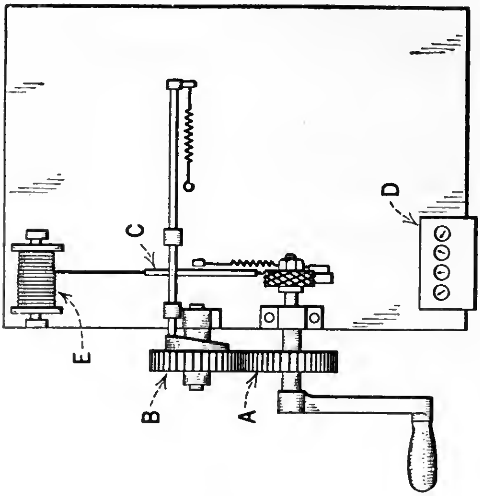


FIG. 2

The arrangement of the various parts on a baseboard. A coil gear; B nozzle feed gear; C feed nozzle; D turn counter; E spool of wire

creases so that the net gain is not as large as it would seem.

NUMBER OF TURNS

THIS depends entirely on the inductance value which we wish the finished coil to have and because the wavelength is proportional to the square root of the inductance (other things being equal). The number of turns depends entirely on the use for which the coil is designed.

SIZE OF COILS

NATURALLY, the factor of space has to be considered and a small coil is better than a big one, provided the efficiency is not sacrificed.

As applied to the super-heterodyne, the intermediate frequency which is created within the set and is used to amplify the signal is of such a value to make necessary large inductances. Small coils wound "scramble fashion" on wooden or bakelite forms are not practical because of the difference in inductance and distributed capacity between the coils, even though they are wound with the same number of turns. In endeavoring to solve this problem the writer devised the machine which is shown in the photographs. The essential features are illustrated in Figs. 1 and 2. It is apparent upon the examination of inductances like spiderwebs, lattice windings, and commercial honeycomb coils that the biggest gain results from the fact that the wires are not close together where they run parallel. This results in a very much lower distributed capacity. Obviously, in order to wind a coil which shall be self-supporting, it is necessary that the feed for the wire should travel sideways back and forth while the coil is being wound. The relation between the speed of rotation of the coil and the speed of the side travel of the feed is what governs the angle at which the successive turns of the coil will intersect, if the nozzle which feeds the wire travels across the face of the coil and back to the original starting point in exactly one turn of the coil, then the wire will always fall in the same place and a "scramble fashion" will result. But now if the feed is adjusted so that for one turn of the coil it has traveled from one side to the other, comes back again but a trifle short, crossing the first turn, then the effect shown in Fig. 4 will be created. Another way of stating this is that for one cycle of the feed, the coil has rotated through one full turn and a little more in the winder.

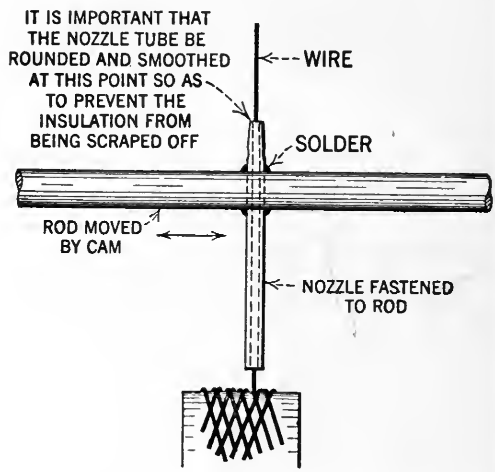


FIG. 3

Shows how the tubular nozzle is mounted and soldered to the cam shaft

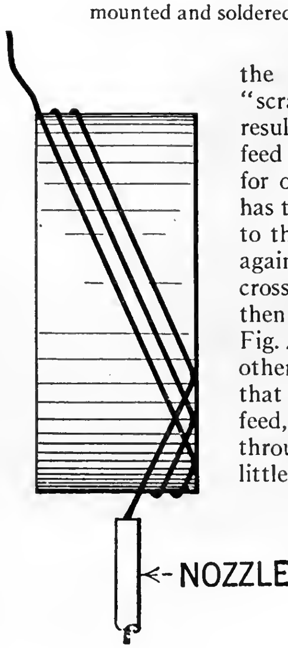


FIG. 4

The standard type of honeycomb coil winding produced by the coil winder

As illustrated this result is obtained by the ratio of the gears A and B. The gear A being on the same shaft with the coil, its rotating is the same as that of the coil, while the gear B being larger than the gear A, turns more

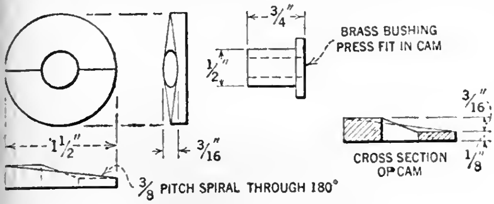


FIG. 5
A working sketch of the cam, the most important unit of the entire device

slowly. Fastened to the gear B is a cam which operates the nozzle C. The shape of this cam is very important. The rate of travel of the nozzle should be constant with practically no time-interval at the end of the travel when the direction is reversed. Therefore, the ideal shape of the cam is that of a straight spiral through 180° and the reverse spiral through the remaining 180°. There is absolutely no way that this cam can be cut except on an end milling machine with a double motion. Any up-to-date machine shop has this equipment and the actual cutting of the cam is a very short process after the milling machine is set up. Fig. 5 is a working sketch of this cam. Its lateral reciprocating action is plainly illustrated in Fig. 6.

THE WINDING MACHINE

OF COURSE, it is absolutely necessary that there is no end play in the mechanism. The shaft on which the coil is wound must run absolutely true in order to prevent

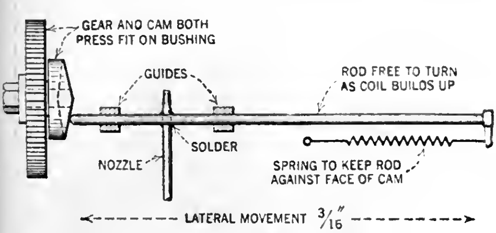


FIG. 6
Illustrates the function of the cam and nozzle

the wire from slipping on the edges of the coil while it is being wound. D in Fig. 2 represents a counter which counts the number of turns being wound. This is likewise almost a necessity because it is very easy to make an error in attempting to count and wind by hand. The writer used a motor with a worm drive with a gear on the main shaft, but any form of drive would serve the purpose.

In using the machine, the wire is first fastened on the end of the shaft and allowed to wind twenty or thirty turns on the bushing D which is clamped on the end of the shaft with a nut. At this point the machine is stopped and a piece of adhesive tape $\frac{1}{8}$ of an inch wide is laid across the bushing with the sticky side up as in Fig. 7. Then the counter is set at zero and the desired number

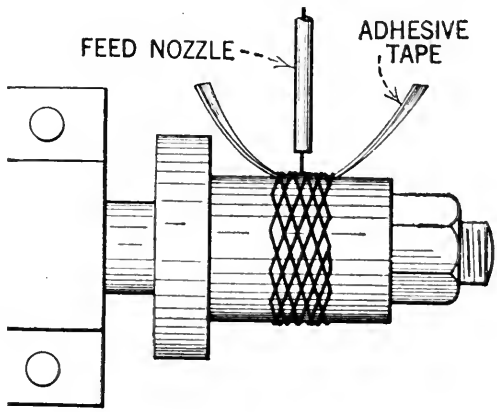


FIG. 7
Preparing the coil for binding with adhesive tape

of turns are wound on. After this, the adhesive tape is brought up over the outer edge of the coil to hold the last turn and the bushing with the coil on it is removed from the shaft. After driving the bushing out of the coil the first twenty or thirty turns are removed from the inside and the finished coil is dipped in a mixture of acetone and celluloid.

By varying the shape of the cam which con-

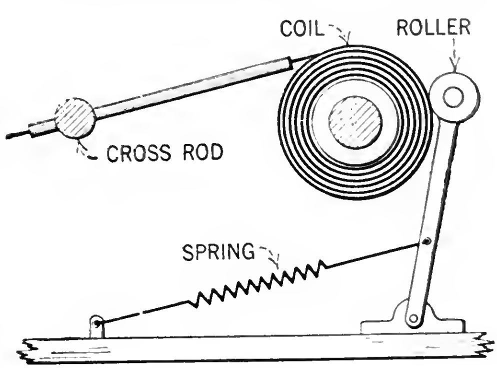


FIG. 8
A detail showing how the roller with spring tension keeps the layers in place

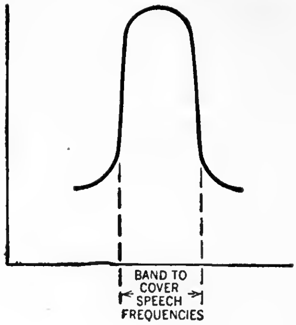


FIG. 9
A curve showing the range of audible frequencies covered by the Hanscom coils

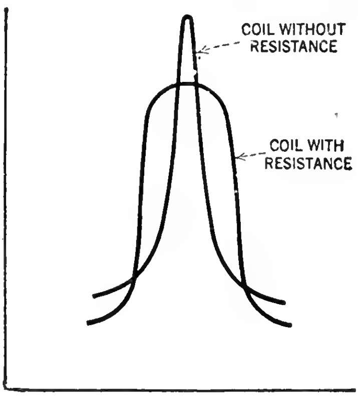


FIG. 10
Illustrates the difference between the Hanscom and other coils, the latter having the tendency to distort by reason of the side bands being chopped off

trols the feed mechanism various effects can be produced, but for average work a $\frac{3}{8}$ of an inch spiral has been found satisfactory. This produces a coil which is $\frac{3}{16}$ of an inch thick. In winding certain kinds of wire it was found advisable to use a roller with a spring tension against the outer edge of the coil as in Fig. 8.

For the intermediate frequency circuit of the super-heterodyne, the writer has used two coils in series, each containing about one thousand turns of No. 36 wire with a .00025 mfd. condenser across the two coils. Various kinds of inductances can be wound on the machine, providing the hole at the end of the nozzle is large enough to permit the wire to run freely through it.

ADVANTAGES OF THESE COILS

THE greatest advantage of these coils is their small size. The magnetic field caused by the coil is naturally small and they can be mounted without much fear of coupling effect with other parts of the apparatus.

In any form of radio inductance designed for reception of music and speech, it is necessary to cover a band of wavelength sufficient to avoid distortion of the voice or music. This is illustrated in Fig. 9 and in the coils designed by the writer this is obtained by the

FIG. 11
Shows a rear view of the winder. A worm-drive motor supplies the means for rotation

resistance in the coils which tends to broaden the tuning sufficiently as illustrated in Fig. 10.

To those who are experimentally inclined, the construction of a coil winder as described will be diverting. The writer can assure those who attempt it that they will wind many coils and near coils before the results are entirely satisfactory. This is not said to discourage those who might desire to build it, but rather as a word of warning. Stick to it and it will work!

THE WINDING DATA FOR THE HANSCOM 'SUPER' COILS

INTERMEDIATE-FREQUENCY transformer—Primaries:—In the first stage, the primary coil consists of 500 turns of No. 36

FIG. 12
The nozzle and cam units are clearly shown. An oscillator coil is on the winding bushing

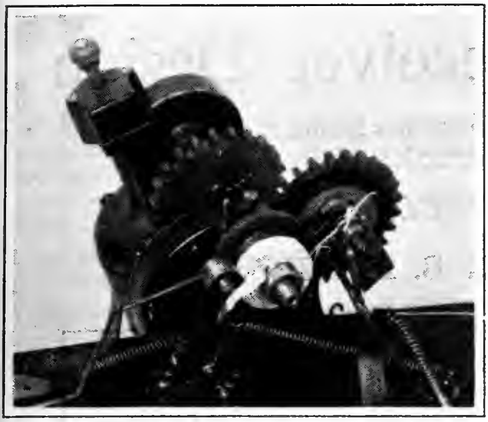


FIG. 13
Another view of the cam and nozzle. Here, also, is shown the method of obtaining tension on the roller bearing, provision for binding and the counter details

s. s. enamel wire. The second stage coil consists of 600 turns of the same wire and the third stage coil consists of 1000 turns of the same size wire.

Secondaries:—Connect two coils in series, each consisting of 1,000 turns of No. 36 s. s. enamel wire for each stage. The first stage coil is tuned by two .0005 mfd., micadons while the second and third stage coils are tuned by a .00025 mfd. micadon, one for each stage.

Oscillator Coils, Grid Circuit:—Two coils are connected in series. The number of turns for these coils depends upon the size of the oscillator tuning condenser and usually varies between 125 and 160. Double cotton covered wire varying in size from No. 24 to No. 28 may be satisfactorily used.

Plate circuit:—Connect two coils in series, using the same size wire as for the grid coils. As few turns as are necessary to make the tube oscillate uniformly over the entire range of the oscillator condenser are used. This number varies between 50 and 75. The inside diameter of the coils is approximately $\frac{5}{8}$." The overall dimensions of a single coil are $\frac{3}{16}$" x $1\frac{1}{2}$".

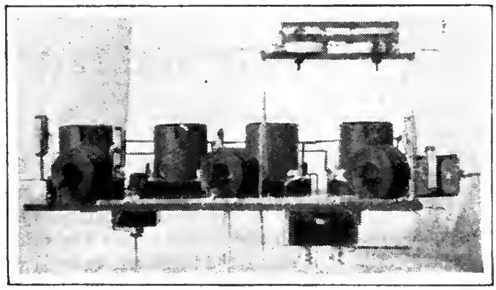
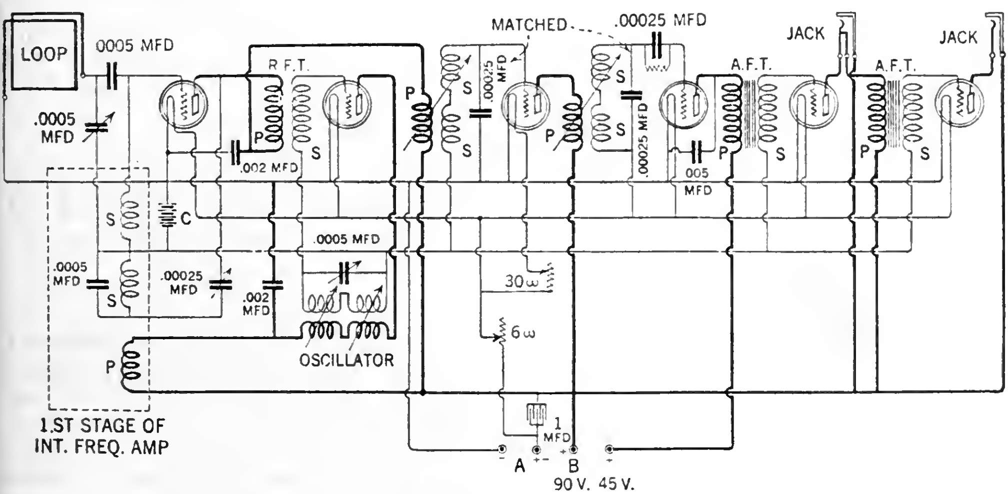


FIG. 14
A completed set of intermediate-frequency amplifier coils mounted in position in an I. F. unit of a second harmonic super-heterodyne receiver

It is important that the .00025 mfd. condensers be matched. A small variable neutralizing condenser may be shunted across one of them and varied until the values of both are equal. This may be considered as one of the minor and semi-permanent adjustments of the receiver.



A CORRECTED CIRCUIT DIAGRAM OF THE SECOND HARMONIC "SUPER"
Minor corrections have been made, particularly in that the by-pass condenser on the first audio-frequency primary is connected from the plate to the negative filament lead instead of as shown on page 44 of RADIO BROADCAST for November, 1924

Problems of Receiver Design

How the Super-heterodyne Combines Sound Elements of Design—Theory of Construction of the "Super"

WHAT MAKES THE WHEELS GO 'ROUND: X

By WALTER VAN B. ROBERTS

IN THIS interesting article, part of Mr. Roberts' series of clear explanatory articles about radio and all its works, the author has not tried to cover the entire field of receiver design, but he has explained some technical points about the super-heterodyne receiver so well that no reader who prides himself on his theoretical knowledge should miss it. This is the tenth article by Mr. Roberts which explains radio theory and practise in his own clear fashion. This first appeared in our magazine for March, 1924.

—THE EDITOR.

IF ALL transmitting stations used the same wavelength (and took turns working) reception would be a much simpler problem. For the receiving set might have as many tuned circuits as the designer had any use for. The owner of the set would not need to change any of the adjustments so there would be no disadvantage, from the operating point of view, in having a very complicated circuit. The idea of the super-heterodyne is simply this: build the very best possible receiving set to work on a fixed frequency (what ever frequency it is easiest to work with), then build a frequency changing device that receives signals on a tuned loop or other antenna and changes their frequency to that for which the receiving set is designed. When tuning-in a station with this combination only two adjustments are necessary: the loop should be tuned to the incoming radio waves, and the frequency changing device should be set to change the frequency to that at which the receiving set is designed to work. Yet in both sensitivity and selectivity this combination has all the advantage given by the large number of tuned circuits and many stages of amplification that can be used in the fixed frequency receiving set.

It is possible that other circuits may be invented in the future that are cheaper or easier to build than a super-heterodyne, but it seems impossible that any could be made to work better because the super-heterodyne can be made ideal from the operating point of view. By taking the trouble to cut condenser plates very accurately to special shapes, the two condensers that have to be changed in tuning-in different stations could be worked simultaneously by a single knob, which leaves nothing to be imagined in the way of simplicity of tuning.

78. BAND FILTERS

IF THE fixed frequency used is fairly low, the fixed frequency receiver can be made to respond equally well to a band of frequencies sufficiently wide for high quality, and yet not respond at all to frequencies lying only slightly outside of this band. This is ideal selectivity and is achieved by the use of a band filter in the fixed frequency receiver. A band filter

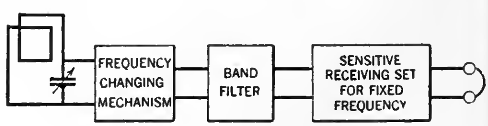


FIG. 65

is a complicated combination of inductances and capacities that allows free passage of frequencies lying inside a given band, but stops all frequencies lying outside that band. Band filters can not be made to select a narrow band from among very high frequencies and so can only be used after the frequency changer has changed the incoming radio signals down to the lower frequency at which the receiver is designed to work. Fig. 65

shows schematically the operation of the super-heterodyne system.

79. HOW THE FREQUENCY-CHANGER WORKS

FIGURE 66 shows a typical frequency changer. Let $e_s \sin st$ be the voltage of signal frequency picked up by the tuned loop. Let $e_h \sin ht$ be the voltage of the heterodyne oscillator's frequency picked up by the small coil coupled loosely to the heterodyne oscillator. The grid potential of the tube is the sum of these two and the C battery voltage, so the plate current will be

$i_p = K\ [B + \mu\ (C + e_s \sin st + e_h \sin ht)]^2$
$+$(small terms that we need not consider here.)
$= K\ [(B + \mu\ C) + \mu\ (e_s \sin st + e_h \sin ht)]^2$
$= K\ (B + \mu C)^2$ which is direct current
$+ 2k\mu\ (B + \mu C)\ (e_s \sin st + e_h \sin ht)$ which are amplified currents of the signal and heterodyne frequencies.
$+ k\mu^2\ (e_s^2 \sin^2 st + e_h^2 \sin^2 ht)$ which reduces to direct currents and frequencies twice the signal frequency and twice the heterodyne frequency.
$+ 2k\mu^2 e_s \sin st\ e_h \sin ht$ which is the only term we have any use for, because it splits up into two parts, one of them — $K\mu^2 e_s e_h \cos (s + h)\ t$ which is the sum of the signal and heterodyne frequencies, and of no interest to us, but the other is $k\ \mu^2 e_s e_h \cos (s - h)\ t$ which is the new frequency that we are going to use. The tuned circuit that connects to the fixed frequency receiver picks up only this frequency. It is obvious that this new frequency can be adjusted to any desired value by simply adjusting the frequency of the heterodyne oscillator. For instance, suppose the fixed frequency receiver is built to work at 100,000 cycles and the radio waves are coming in at a frequency of 1,000,000. If we adjust the heterodyne to oscillate at 900,000 cycles the new frequency will be the difference of the two, or 100,000, which is just right to be picked up and received by the fixed frequency set. On the other hand if the heterodyne oscillator is adjusted to 1,100,000 the difference will again be 100,000 so that there are evidently always two possible settings for the heterodyne condenser either of which produces the proper frequency for the fixed or intermediate frequency receiver. Sometimes there is less interference experienced when using one of these settings than the other but usually it makes no difference. From the coefficient of the new frequency term it is evident that its strength depends upon the amount of voltage picked up from the heterodyne oscillator as well as the signal itself. Hence this should be made large by making the coupling to the heterodyne oscillator sufficiently close. The C battery voltage should be greater than the heterodyne voltage in order to keep the grid at all times negative. The best C and B battery voltages and best coupling can be most simply found by experiment.

80. PROBLEMS OF "SUPER" DESIGN

IN THE actual construction of a super-heterodyne, we are caught between two fires. On the one hand, if we build the fixed, or intermediate-frequency receiver to operate at a fairly high frequency, say one or two hundred kilocycles, we will have difficulty in making it sensitive and selective enough. On the other hand, if we use a very low intermediate frequency, say 30 kilocycles, we are

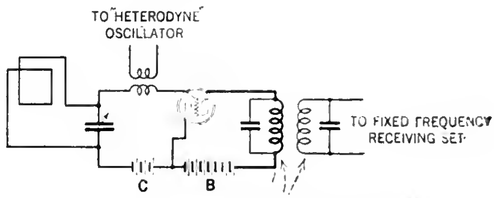


FIG. 66

likely to run into two troubles. The first is that the quality tends to be bad on account of the selectivity being too great, and the other is that unpleasant complications occur in operating the set, due to the signal and heterodyne frequencies being so nearly equal. As the heterodyne condenser is varied there may be a click when the heterodyne frequency passes the value for which the signal circuit is tuned. Also, the same setting of the heterodyne condenser will often bring in two different stations at once whose frequencies are really different by twice the intermediate frequency used, and when the latter is very low, these two frequencies are too close together for the signal circuit or loop to select one to the exclusion of the other.

In view of these considerations three courses seem to be open: (1) to effect the best compromise between the advantages and disadvantages of high and low intermediate-frequency amplification, the choice depending upon what is desired of the set and the location where it is to work, (2) to use the best intermediate frequency for amplification and quality and use a frequency changing device employing special circuits so arranged that only

one station can be received with a given heterodyne condenser setting —and hence conversely only one heterodyne condenser setting will bring in a given station—and (3) to use *two* intermediate frequencies, first a very high one to avoid the complications of tuning that accompany the low "I. F.", then by means of another heterodyne (this one being fixed once for all) changing down to the best frequency for quality and selectivity and amplification. As there are obvious objections to all three courses, it cannot be said that the goal has yet been reached, although the super-heterodyne *method*, the idea having the bulk of the receiving set working at fixed frequencies and requiring no tuning adjustments, does not seem capable of improvement.

The chief fundamental methods of reception have been outlined but no attempt will be made to discuss all the circuits in use as nearly all are merely combinations of the methods discussed. For example, regeneration can be combined with the neutrodyne type of amplification by putting a variometer in the plate circuit of the detector tube. Again, the fixed frequency receiver of a super-heterodyne set may make use of neutrodyne amplification and reflexing.

Captain Larkin on Radio

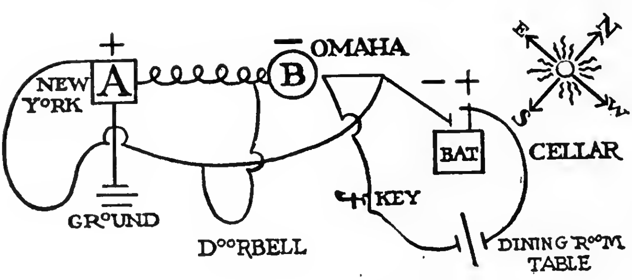
CAPTAIN LARKIN, one of the many heroes in "Mr. and Mrs. Haddock Abroad" by Donald Ogden Stewart, finds himself locked in a watertight compartment of his own vessel while showing some of his portly and pompous passengers about the ship. Several of the passengers suggest means of escape, but the suggestion of the Captain himself is by far the most masterly. He, like the Sheriff of Nottingham in "Robin Hood" has brought his "massive brain and eagle eye" to bear, and his solution of the dilemma is radio. The following diagram and conversation are reproduced from the book which is copyrighted by George H. Doran and Company, 1924.

"Well," said the Captain, "my plan rather ingeniously makes use of radio. Have you got a piece of chalk, Mrs. Gerrish?"

"I think so," said Mrs. Gerrish, feeling in her pockets.

"Here's one," said Mrs. Haddock. "Is yellow all right?"

"Yellow will do, I think," said the Captain, and taking the chalk he drew a rather complicated diagram on the side of the wall, somewhat as follows:



THE RADIO DIAGRAM THAT SOLVED THE PROBLEM
How to escape from a water-tight bulkhead

"Now," he said, "do you know anything about radio?"

"My son got Pittsburgh one night," said Mr. Haddock, "but there was a lot of static."

"What were they playing?" asked Mrs. Gerrish.

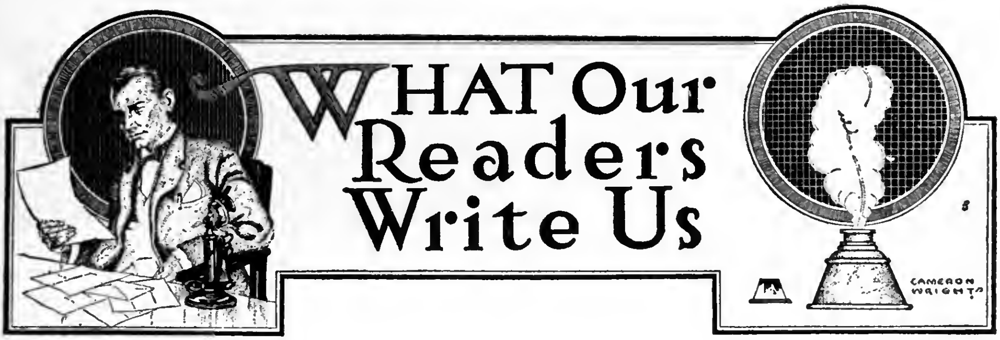
"It was some sort of a jazz band," said Mr. Haddock.

"I like opera best," said Mrs. Gerrish, and she hummed a few of the more important notes from "Faust." "That's from "Rigoletto".

HOW TO SELECT A B BATTERY ELIMINATOR

IS THE subject of an interesting article which will appear in an early number of RADIO BROADCAST. There are many points to be considered in purchasing and operating a current-tap device, and this article, written by a radio man of long experience, will be of great value to prospective purchasers.

WHAT Our Readers Write Us



A Word from an Enemy—of the Single Circuit

IT IS growing more and more plain that the enemies of the single-circuit receiver are legion and are increasing in numbers and in intensity of their opposition. As has often been remarked about the unfortunate wide-spread use of the single circuit set, abolishing it is so largely a matter of militant public opinion that results come a bit slowly. RADIO BROADCAST has in the last two years, lost some "friends" by its constant advocacy of the abolishing of the radiating receiver, chiefly among advertisers, be it said. It is interesting to note that now, very very few single-circuit receivers are marketed by manufacturers who make even faint claims to be reputable.

Editor, RADIO BROADCAST
Doubleday, Page & Company,
Garden City, L. I.
DEAR SIR.

I wish to compliment Mr. Willis K. Wing on his excellent summing up of "The Case Against the Radiating Receiver," but if it is in order, I would suggest a final point with which he might have rounded out his remarks on the single-circuit receiver.

Even if it were not for its severe radiation, the single-circuit set is not even selective enough to merit its consideration as a broadcast receiver. The recent Department of Commerce ruling calling for a compulsory quiet hour from 7 to 10.30 P. M. on the part of amateur stations was necessitated by the fact that at that time the single-circuit was the commonest type of receiver in use. This was not on account of the fact that amateur continuous wave stations actually created interference themselves, but simply because the single-circuit users were not able to tune the near-by stations out, which is, in a sense, unfair to the amateur.

This affliction of broad tuning which also gives the same trouble when the receiver is in a few miles of a broadcasting station, is caused by the fact that when resistance is included in an oscillatory (tuning) circuit, the tuning of that circuit is made broad. In the single-circuit tuner, the coil, condenser, and antenna are all connected together as to form one circuit, hence the name. Unfortunately, however, antennas have resistance, and most of those built for broadcast reception have comparatively high resistance, so that the antenna being included in the circuit through which the signals enter the detector causes the tuning to become broad. When the tuner is set for a broadcasting station, any other transmitter being operated in the neighborhood on almost any other wavelength will be heard, probably all over the dial.

The remedy for this is to "loose couple" the set; in other words, to bring the antenna and ground leads to a separate coil to be coupled to the grid tuning coil. The honeycomb coil tuner is the outstanding representative of this method of construction, and the so-called three-circuit regenerator as well.

H. S. G., Kitchener, Ontario.

A Radio Samaritan

IT IS most interesting to notice how the gospel is reaching all through the country and how the feeling against the squealing or radiating receiver has taken practical form. People, wherever possible, are getting to do something about this unfortunate situation rather than merely holding forth at great wordy length.

Editor, RADIO BROADCAST
Doubleday, Page & Company,
Garden City, L. I.
DEAR SIR.

Since reading your article "The Case Against the Radiating Receiver" in the October RADIO BROADCAST, I came across this notice in our local paper.

B. N., Gloucester, Massachusetts.

RADIO CONDITIONS IN GLOUCESTER LAST NIGHT

Conditions were good last night. Most stations came through strong. There was very little fading and static.—R. P. M.

WARNING

If the person in the vicinity of Center Street who tunes in morning, noon and night and never gets the station clear without squealing, will please call at my shop, 101 Main St., with his or her radio set. I will make the necessary adjustments and changes in the set free of charge, so that above party will enjoy his radio more, and others in this neighborhood may enjoy theirs also.

R. P. MERCHANT.

WHEN YOU WRITE THE GRID . . .

Don't fail to enclose a stamped, self-addressed envelope with your inquiry if you expect a personal reply.

Don't be impatient if you do not receive an immediate answer. Every letter is answered in the order of its receipt. Do not send a second letter asking about the first.

Look over your files of RADIO BROADCAST *before asking a question which might have been covered in a previous issue.*

Don't ask for a comparison between manufactured apparatus. The addresses of manufacturers of articles used in the construction of apparatus described in RADIO BROADCAST *will be given on request.*

Don't include questions on subscription orders or inquiries to other departments of Doubleday, Page & Co. Address a separate inquiry to The Grid.

Don't send us a fee for answering your questions. The Grid Department is maintained for the aid and convenience of readers of RADIO BROADCAST *and there is no charge for the service.*

QUERIES ANSWERED

What is the trouble with my Roberts receiver when it is possible to receive with the detector tube removed from its socket?

C. J. S.—Brooklyn, N. Y.

Will you print a six-tube circuit for use with a loop?

G. H.—Chillicothe, Ohio.

I would like a radio-frequency, reflex, audio-frequency, crystal detector circuit employing three tubes.

T. L. G.—Philadelphia, Penna.

May I have a diagram for a one-control one-tube reflex circuit?

L. B.—Austin, Texas.

How are jacks used in radio circuits?

J. P. N.—Savannah, Ga.

I would like a power amplifier circuit employing push-pull transformers.

E. T. J.—Detroit, Mich.

How may I prepare a calibration curve for my receiver?

C. M. D.—Springfield, Mass.

Explain how I may make a change-over switch for testing receivers.

A. C. F.—Freeport, L. I. N. Y.

TESTING THE ROBERTS CIRCUIT

A GLANCE at any of the Roberts Knockout circuits will show us that they are composed of two very important units, namely the neutralized radio-frequency amplifier and the regenerative detector. The audio-frequency amplifier addition is either of the audio-transformer or the resistance-coupled type or a combination of both. Just now we are interested in the two-tube tuner. Not a few questions similar to C. J. S.'s have been received and we endeavor to clear up the situation with the following explanation.

It is quite evident that the radio-frequency amplifier, in this case, is functioning as a detector unit rectifying the incoming signal without the aid of the regenerative detector. In Fig. 1 is shown a circuit that will aid in putting the entire receiver

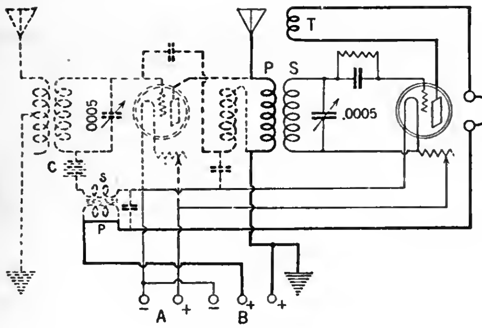


FIG. I

into proper operating condition. Here, the radio-frequency amplifier with reflexed audio amplifier is eliminated from the main circuit so that the result is a straight three-circuit regenerative receiver. The primary of the audio-frequency transformer is shorted and a pair of phones inserted in series in the plate lead of the detector tube. The first tube is removed from the socket and the antenna and ground are connected to the plate terminal of the first socket and the B90 post, respectively. By bringing the tickler close to the secondary and rotating the variable condenser, a regenerative squeal should be heard in the phones and if the detector responds correctly, carrier waves of transmitting stations will be tuned-in. If this is not the case then the coils should be inspected for reversals of connections, or reversals of windings. The grid leak and condenser may be defective or the tube is not making proper contact with the socket blades. By means of a progressive trouble-elimination system it is possible finally to make the necessary corrections so that the first tube in the radio-frequency amplifier circuit may again be thrown in and the operation observed. Other trouble-shooting suggestions were contained in the January, 1925, GRID.

A SIX-TUBE LOOP SET

FOR those who want a multi-tube radio frequency amplifier-detector-audio-frequency amplifier circuit with preferably one tuning control, the circuit shown in Fig. 2 is suggested. A receiver employing such a circuit may be easily constructed as a portable set, having the batteries contained in the cabinet as a part of the receiver. A loop consisting of about 12 turns of No. 18 d.c.c. wire wound on a 2 ft. square frame, shunted by a .0005 mfd. condenser will effectively cover the broadcast range of wavelengths. The use of an antenna and coupler is inadvisable as the chances for radiation are too great. The radio-frequency transformers to be used in this circuit are of the untuned type having an average wavelength range of 200 to 550 meters. If it is desired, the tuned type of transformer with a variable condenser shunting each secondary may be employed, but the tuning becomes increasingly difficult for each stage used. The potentiometer allows the circuit to be adjusted to its most efficient point of operation and also controls to a large degree the tendency of the receiver to oscillate. As a further oscillation control it may be necessary to connect the return lead of the grid circuits of the second and third tubes to the potentiometer arm.

A THREE-TUBE R. F.-A. F. REFLEX RECEIVER

MR. T. L. G. asks for a circuit consisting of two stages of radio-frequency amplification, crystal detector, one stage of reflexed audio-frequency amplification through the second stage of radio and a stage of straight audio. This circuit appears in Fig. 3. One rheostat of ten ohms is sufficient for controlling all three tubes. The radio-frequency transformers used are standard neutroformers, the secondaries of which are shunted by .00037 mfd. condensers. The audio reflex transformer should be of a low ratio as should the stage of straight audio. A C-battery is inserted in the reflex stage and the last audio stage for stabilization purposes. Two jacks situated in the circuit as shown allow the use of two or three tubes. In this circuit it is absolutely essential that a good crystal be used for satisfactory results. UV-201-A's are used throughout.

A ONE-CONTROL, ONE-TUBE REFLEX RECEIVER

FIGURE 4 shows a revamped one-tube crystal reflex receiver having one control. The coupler T1 may be the standard variocoupler obtainable on the market or it may be of the type employed in the RADIO BROADCAST one-tube Knockout receiver

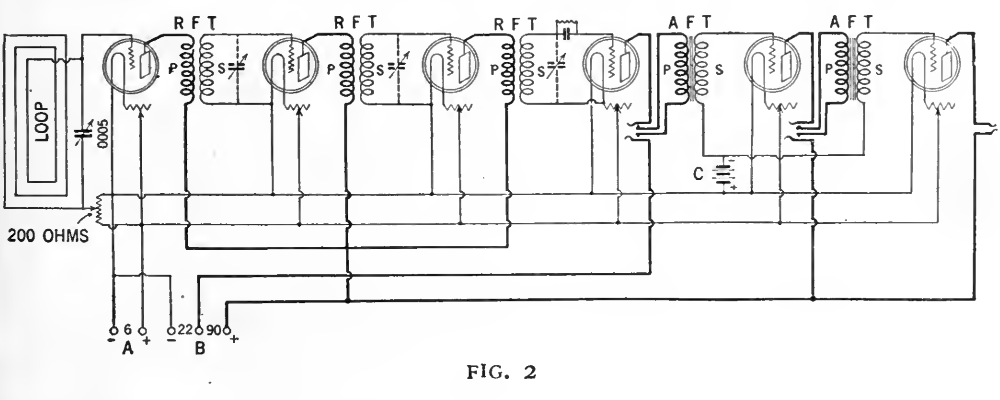


FIG. 2

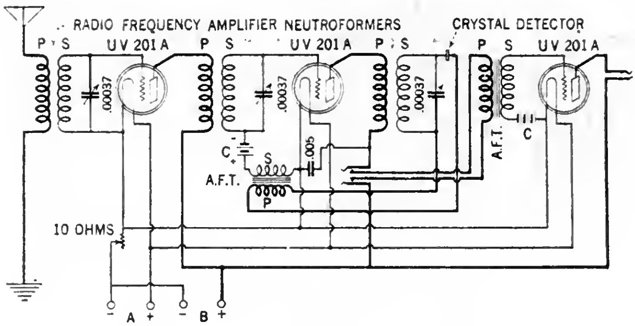


FIG. 3

and will not be repeated here. The suggested circuit is shown in Fig. 6. Any standard type of tubes may be used in a unit of this kind but of course UV-201-A's or better still, power tubes such as the 202 or the W. E. 216-A will be more suitable for this type of work. The value of C battery will vary in proportion to the amount of B battery used. A table of C battery voltages was included in THE GRID for January, 1925. For the tubes suggested 120 to 150 volts B battery will be sufficient.

as explained in the April, 1924, RADIO BROADCAST. The radio-frequency transformer T2 is of the untuned type and covers a wavelength range of 200 to 550 meters. Much of the instruction as outlined for the three-tube circuit of Fig. 3 may be followed in the construction of this receiver. Especial care should be exercised in the selection of a suitable audio-frequency transformer and crystal.

JACKS, AND HOW THEY ARE USED

THERE are as many types of closed circuit jacks as there are manufacturers of them. It should be remembered that jacks are used for the sole purpose of providing a mechanical cut-in on any part of a radio circuit. In the natural progress of things, jacks came to be used in more elaborate ways. One manufacturer produces 14 different kinds of jacks. Not all of them can be explained here but several of the more well-known type are illustrated in Fig. 5, A and B. In A, the several styles are outlined and their use is depicted in B. For the output jack in the stage of an amplifier or a plain detector circuit we have that as shown in 1. This is called the single open-circuit type. In 2 is shown a single-closed circuit type permitting the throwing in or out, automatically, of the primary of a transformer. Another method of performing the same operation is shown in 3. That shown in 4 is fundamentally the same as that shown in 1 except that a filament control is included which breaks the filament circuit when the plug is withdrawn from the jack.

In 5 we have practically the same as that shown in 2 with the addition of the filament control as explained. The method of controlling one or more filament circuits by means of jacks is shown in 6.

A PUSH-PULL POWER AMPLIFIER

IN THE construction of a push-pull amplifier, the selection of satisfactory parts plays an important role. In fact, the ultimate successful operation of the unit depends upon this consideration more than anything else. The input stage audio transformer should have a low ratio, say 2 to 1, so that the voice and music is not unnecessarily distorted before it reaches the push-pull transformers. The action and theory of operation have already been explained in past issues of RADIO BROADCAST

CALIBRATION CURVES

ALMOST any type of receiver may be charted and calibrated so that a graphical curve is produced that may be used for reference purposes. Instead of rumaging through numerous papers having dial settings numerically listed, it is much easier and more efficient to refer to the ship-shape wavelength curve that also helps you to locate new station positions on your tuning dial. Neutrodyne and tuned radio-frequency receivers, superhetrodynes, and crystal reflex receivers furnish the most accurate curves. In the regenerative type of receiver, several combinations of inductance and capacity will tune to the same station and the curve system of tuning is not so dependable or reliable. A specimen of a wavelength graph curve is shown in Fig. 8. The several points marked on the diagonal line indicate station positions. For instance 492 meters, WEAF, is located on the vertical border to the left; running across horizontally on the 492 line we note where it is intersected by the diagonal line. Then, coming down vertically, it is found that this position is equal to 81 on a 100 segment semi-circle of the dial. This base line is comparative to and indicates the markings on the dial. To prepare a wavelength curve it is well to have commercial graph paper that is obtainable in most stationery shops. The dial markings are laid off at regular, equal intervals along the base line and the wavelength range, usually from 200 to 600 meters is laid off in a

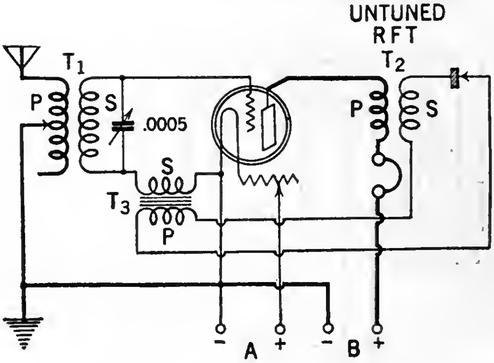


FIG. 4

MAGNAVOX Radio

Receiving Set TRF-5 with Reproducer M4 - $125.00

MAGNAVOX
Reg U.S. Pat. Off.

EXPERIENCED radio users have stated that this Magnavox equipment (illustrated below) represents the highest standard of real value and usefulness ever offered in the radio field.

The Magnavox 5-tube circuit is a special development of tuned radio frequency in which a splendid balance of selectivity, range and volume have been attained. The one dial Station Selector eliminates all tuning adjustments; while the Magnavox Reproducer insures sonorous, pleasing tone for all programs.

★ *Magnavox Radio Receiving Sets, Tubes and Reproducers are carried by reliable dealers. Illustrated booklet on request.*

THE MAGNAVOX COMPANY
OAKLAND, CALIFORNIA

New York: 350 West 31st St.
Chicago: 162 N. State Street
San Francisco: 274 Brannan St.

Canadian Distributors: Perkins Electric Limited, Toronto, Montreal, Winnipeg

2R

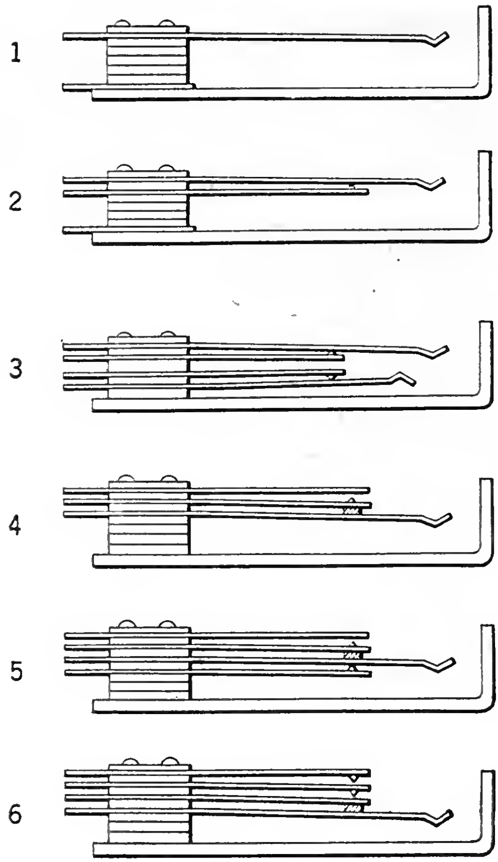


FIG. 5A

like manner on the vertical left border line or vice versa. Beginning at the lower wavelengths, the dial position for the stations tuned-in on the receiver are located by cross-reference continuing until the maximum setting has been obtained. A line is then drawn from point to point resulting in a continuous curve. Not all curves will be very straight as the settings at the lower wavelengths are crowded closer together than at the higher settings. The curve shown in Fig. 8 is an exaggerated example to serve as an illustration. A more correct form is shown in Fig. 7.

BATTERY SWITCHES FOR TESTING SETS

IN MAKING comparison tests between radio sets, it is advantageous to have a double throw switch by which either of two sets may be quickly connected to the antenna and ground and to the batteries. The arrangement of a switch to do this is complicated by the fact that various manufacturers use different methods of connection between the A, B, and C batteries.

Considering only two plate voltages and one bias voltage, a nine-pole double throw switch would seem to be required in order to prevent short circuit of the

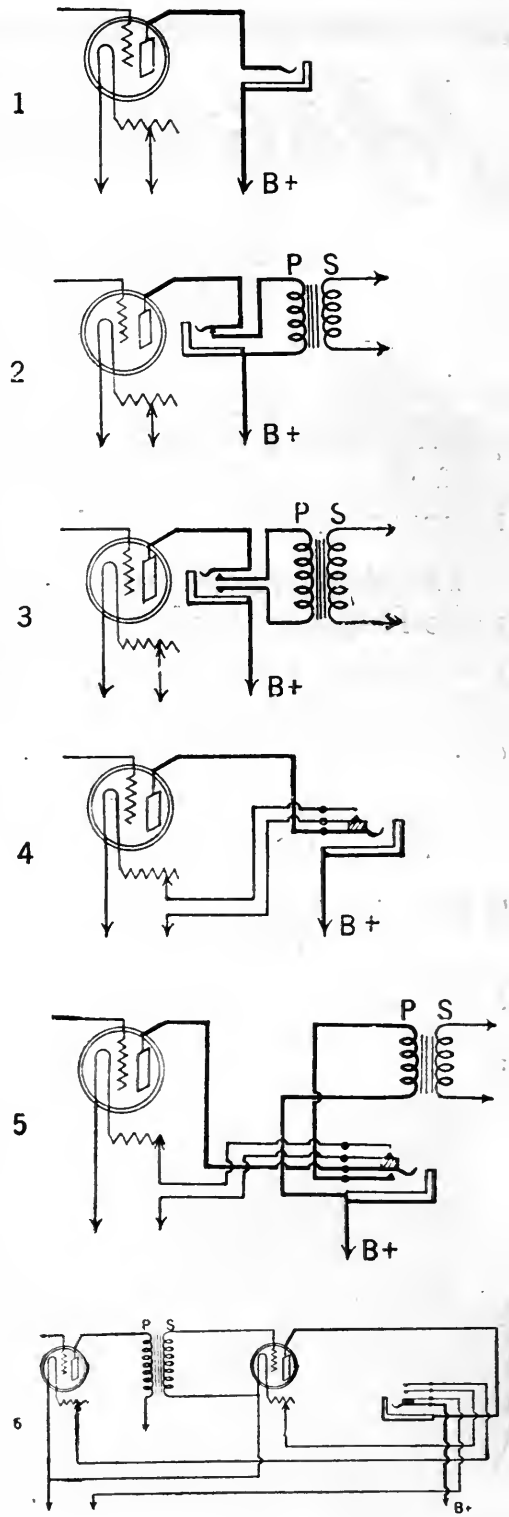
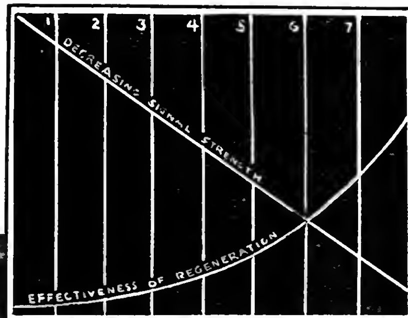


FIG. 5B

Graph showing how the regenerative effect in the Model L-2 Ultradyne increases as the strength of the recede decreases



Why the ULTRADYNE Gets Distance on the Loud Speaker!

The ULTRADYNE Kit

consists of 1 Low Loss Tuning Coil, 1 special Low Loss Coupler, 1 type "A" Ultraformer, 3 type "B" Ultraformers, 4 matched fixed Condensers.

To protect the public, Mr. Lacault's personal monogram seal (R.E.L.) is placed on all genuine Ultraformers.

$30.00

UNLIKE other Super-radio receivers, the Ultradyne, with its exclusive use of the "Modulation System".and special application of regeneration, is capable of detecting and regenerating the faintest signal, making it audible on the loud speaker.

The regenerative effect in the Ultradyne increases as the strength of the signal decreases, until the signal becomes so weak that no amount of amplification will make it audible.

A radical advance in radio engineering and the latest development of R. E. Lacault, E.E., A.M.I.R.E., Chief Engineer of this Company and formerly Radio Research Engineer with the French Signal Corps Research Laboratories.

You will marvel at the unusual selectivity, sensitivity and range of this new Model L-2 Ultradyne.

Write for descriptive circular

How to Build and Operate the ULTRADYNE

32-page illustrated book giving the latest authentic information on drilling, wiring, assembling, and tuning the Model L-2 Ultradyne Receiver.

50c

ULTRADYNE

MODEL L-2

Phenix Radio Corporation

5-7 Beekman Street
New York City

R E L

★ Tested and approved by RADIO BROADCAST ★

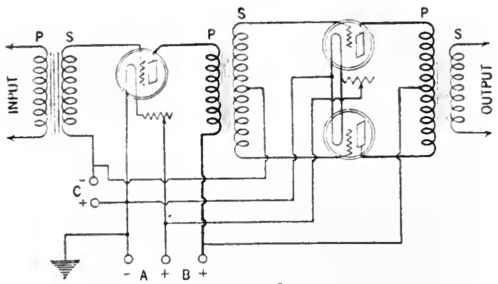


FIG. 6

batteries due to differences in inter-connection in the sets. These nine points would be:

Antenna 90 45 -B +A -A +C -C Ground

An investigation shows that a six-pole switch can be made to do the work, because the 90 volt, the 45 volt, and the -C are all insulated in any receiver. These three points can therefore be omitted from the switch and terminals can be provided for them to which all the sets may be permanently connected as indicated on the instruction card. The switch will then carry:

Antenna -B +A -A +C Ground

This arrangement has the further decided advantage that terminals can be provided for various B and C battery voltages and the sets under test can be connected directly to these terminals. For example, terminals can be provided for 22, 45, 90 and 135 volts B battery and for $4\frac{1}{2}$ and 9 volts C battery. Inasmuch as opening the switch disconnects the -B and the +C, and disconnects the A battery entirely, from all sets, there is no possibility of a short circuit, due to differences in inter-connections.

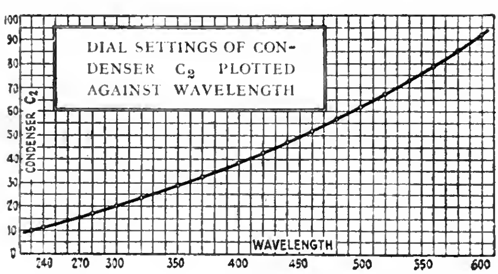


FIG. 7

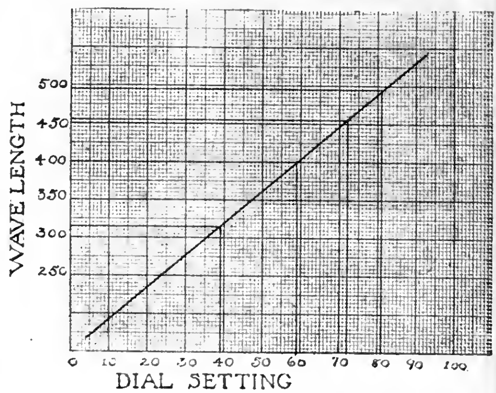


FIG. 8

EXCLUSIVELY IN RADIO BROADCAST

MUCH interest has recently been aroused by the announcement that photographs have been successfully transmitted across the Atlantic, and from point to point in this country by radio. As everyone realizes, the successful transmission of photographs means that one could send practically as well complete printed pages. Signatures to valuable documents could be exchanged, as could photographs of the documents, at great distances. The other possible applications of this new branch of radio are pretty well known. RADIO BROADCAST *has arranged to print a series of articles describing a method of radio transmission which has never yet been published. Experiments have been in progress for more than two years, along lines totally different from those of the Jenkins system and the Ranger system, of the Radio Corporation. These articles will contain some very startling revelations from the point of view of radio photograph transmission. There is no announcement we have made in many months which should so interest the reader who prides himself on following the latest developments in the field.*

Dry "B" Batteries are an economical, dependable and convenient source of plate current!

No. 770. 45-volt extra large vertical. For heavy duty only. The ideal "B" Battery for use on multi-tube sets. Price $4.75.

★

Scientists constantly improve battery quality

EVEREADY "B" Batteries today contain more electricity, more service, more satisfaction than ever before.

Processes evolved by the scientists of the Union Carbide and Carbon Research Laboratories, Inc., when put in effect in the Eveready factories, are responsible for this great accomplishment.

At the same time the factories have effected a still higher standard of workmanship. A system of inspection that is a marvel of efficiency was inaugurated. The results, gratifying beyond measure, were accomplished with a speed and completeness that have few parallels in industry. The final tests showed more electricity, more battery service, greater Eveready satisfaction without increasing battery sizes *and with a substantial reduction in price.* "B" Battery operating costs, using the new Evereadys, in most cases show a reduction of at least one-half.

There is an Eveready Radio Battery for every radio use.

Insist on Eveready "B" Batteries.

Manufactured and guaranteed by
NATIONAL CARBON COMPANY, INC.
Headquarters for Radio Battery Information
New York San Francisco
Canadian National Carbon Co., Limited, Toronto, Ontario

EVEREADY HOUR
EVERY TUESDAY at 9 P. M.
(Eastern Standard Time)
For real radio enjoyment, tune in the "Eveready Group." Broadcast through
WEAF New York WJAR Providence
WEEI Boston WFI Phila.
WGR Buffalo WCAE Pittsburgh

EVEREADY
Radio Batteries
—they last longer

New Equipment

DE FOREST LOUD SPEAKER

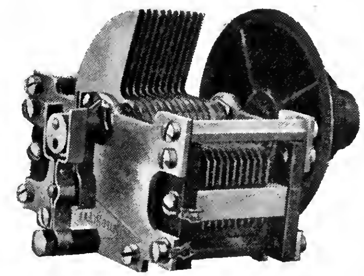
A reproducer of good design and quality which compares very favorably with other speakers of the same price range. It delivers good volume on both speech and music, still maintaining good tone quality. Made by the De Forest Radio Company, Jersey City, New Jersey. Price $25

ANTENNAPHONE

A very neat indoor aerial. It is only necessary to place your house telephone upon the antennaphone plate and connect the lead to the antenna binding post of your receiver. Made by The Antennaphone Co., 90 West Street, New York City. Price $1.00

NATIONAL BATTERY

This is a 24-volt unit wet B battery of good construction. The connectors between the several cells protrude above the sealing so that it is possible to tap off at any desired voltage. Made by the National Lead Battery Company, 1704 Roblyn Ave., St. Paul, Minn.



U. S. L. CONDENSER

A well made instrument which has a good capacity range. The vernier action, which shows at the back of the condenser, is controlled by the small knob acting through the center of the main dial. Made by The United Scientific Laboratories, Inc., 92 East 10th Street, New York City

THE A-C DAYTON XL-5

A five-tube set using tuned radio-frequency, detector and audio-frequency amplification. The radio-frequency transformers are of special design. Very satisfactory performance is possible with this receiver. Made by The A-C Electrical Mfg. Co., Dayton, Ohio. Price $115

PERFECTO SOLDERING FLUID—A convenient and satisfactory, non-acid soldering flux that insures positive soldered joints. John Firth & Co., 25 Beaver St., New York City

FADA Radio

★

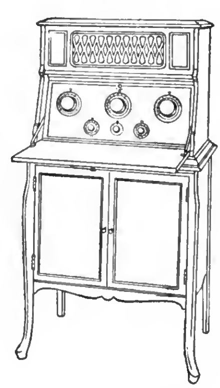
FADA Neutroceiver
No. 175-A
Mahogany cabinet. Inclined panel and roomy battery shelf. 5 tubes. Price (less tubes, batteries, etc.) $160.

Indecision vanishes when you hear the FADA

RADIO shopping ends triumphantly when you find the FADA. People who know radio and have conducted comparative tests say that the Neutroceiver is the best they have ever tried. Have the FADA Neutroceiver demonstrated in your home. Listen to its marvelously faithful reproduction. Tune in a distant station yourself loud and clear and see how easy it is. Observe the beautiful cabinet design. You will exclaim: "At last! This is just the radio set I want!"

If you prefer a set with self-contained loud speaker, the FADA Neutrola Grand meets your desire in this respect, as in all others. Whether FADA Neutrodyne receivers are the first or the fifteenth make you investigate, they will be your final choice. Through the FADA Neutrodyne your radio wishes become realities. See your dealer.

LICENSED BY INDEPENDENT RADIO MANUFACTURERS, INC.
NEUTRODYNE
REG. U.S. PAT. OFF.
PAT. MARCH 27 1923 AND APRIL 1, 1924 HAZELTINE PATS. NOS 1450080 AND 1489228 OTHER PATENTS PENDING
F. A. D. ANDREA INC. 1581 JEROME AVE. N.Y.C.



FADA Neutrola Grand
No. 185/90-A
The five-tube Neutrola 185-A, mounted on FADA Cabinet Table No. 190-A. Price (less tubes, batteries, etc.) $270.

E. A. D. ANDREA, INC., 1581 JEROME AVENUE, NEW YORK

★ Tested and approved by RADIO BROADCAST ★

Among Our Authors

THE cover of this month's Radio Broadcast was done by Remington Schuyler, who is a well-known painter of outdoor scenes. Mr. Schuyler is regarded especially highly for his authentic canvasses of Indians. The February cover, with the R–B Lab as its subject, was "done from life." The masts and radio cabin are faithfully portrayed, but the bulk of the Doubleday, Page & Company buildings, some five hundred yards away, have been omitted from the painting.

MYRA MAY writes: "For the last ten years I have been trying to understand just what makes an automobile run. Just as I was reaching a point where I understood the difference between a clutch and a snubber, along comes radio, with its confusion of grids, antennae, and heterodynes. Up to date, I have learned that if you use your fingers for a plug, you move your hand away quickly. That lesson so well learned, I haven't the heart to go further into the subject."

WILLIAM P. GREEN, whose second article on "The Way of the Transgressor" appears this month, has done some very effective work in keeping the advertising and sale of radio goods in the path of the righteous. His headquarters are in New York.

JULIAN KAY, an old-time radio worker, has just finished his requirements for a doctor's degree in physics at Harvard University. We expect soon to print more of his eminently readable and interesting radio articles.

DUDLEY SIDDALL

DUDLEY SIDDALL admits that he was born in Kalamazoo, Michigan. It is an interesting fact that few non-Michigan residents can pronounce that name with the loving drawl peculiar to the native. Mr. Siddell discovered New York in 1919 and found that Wall Street celebrates more business holidays than any other place in the United States. His greatest achievement, he says, was to spend fifteen years in newspaper work without once being a copy-reader. He is now in the advertising business and enjoys breaking the news to newspaper men that "I used to be a newspaper man myself."

D. S. KNOWLTON

WHEN the Union Trust Company, in Cleveland, decided to establish a broadcasting station, Don S. Knowlton from the bank's advertising department was drafted to arrange the musical programs and was later put in charge of the station.

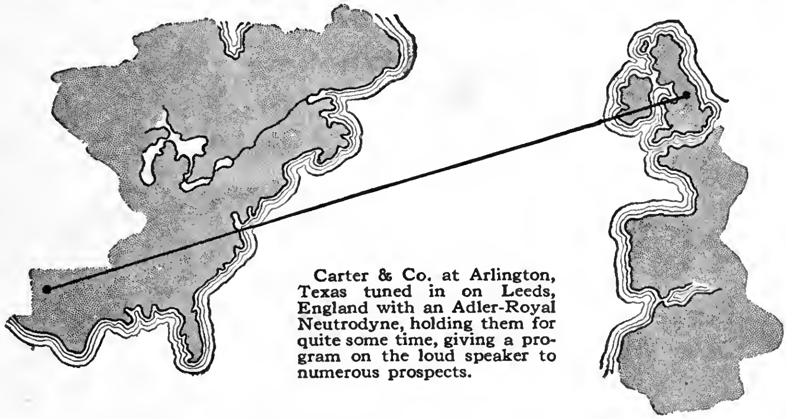
ZEH BOUCK had the even tenor of his way greatly broken up the other day when he observed in the *Radio Service Bulletin* of the Department of Commerce, that Senatore Marconi had been granted an English patent on "bean transmission." Mr. Bouck is wondering just why the noted Italian has forsaken applied physics for applied cookery.

JOHN C. DAVIDSON is a commercial radio engineer whose experience in the field dates back to very early days. Since broadcasting came into popularity, he has been devoting his talents to the design of radio parts, some of which, especially a fixed crystal detector, are widely used.

ALLAN T. HANSCOM is a resident of Woonsocket, Rhode Island, and a graduate of the engineering school of the University of Pennsylvania. His article in the November Radio Broadcast on a second-harmonic super-heterodyne has attracted wide attention among that great group of radio enthusiasts who are intensely interested in anything to do with that highly efficient receiver.

CAPTAIN P. P. ECKERSLEY is the man responsible to the British radio public for their radio programs, being chief engineer of the British Broadcasting Company. Much of the material in his article was presented to the recent Radio Conference in Washington, called by Secretary of Commerce Herbert Hoover.

Two Big Radio Thrills



Carter & Co. at Arlington, Texas tuned in on Leeds, England with an Adler-Royal Neutrodyne, holding them for quite some time, giving a program on the loud speaker to numerous prospects.

YOUR first thrill with an Adler-Royal neutrodyne will be the magic spell of D.X. as station after station comes in clear as a bell with the slightest change in dial settings. No matter how much you know about radio, the performance of Adler-Royal will be a remarkable radio experience for you. The selectivity you had hoped for has really been accomplished.

Then, as your own log grows, you will be more discriminating about the quality of what you hear. You will begin to appreciate what Adler-Royal really is and this will be your biggest thrill. Your daily paper will be your program. You will learn to depend on Adler-Royal absolutely.

The Neutrodyne principle is so far perfected in Adler-Royal that even in the hands of a novice its selectivity and pure tone qualities are almost automatic. Its operation is as simple as setting a clock. There are no squeaks, squeals or howls to ruin radio enjoyment. Adler-Royal has conquered the mysteries of the air.

Seek a Service Dealer

THE dealer from whom you buy a radio set is quite as important as the set you buy. On his service to you, much of your enjoyment of a radio set will depend. It will pay you to turn the corner into Main Street to find the Adler-Royal dealer. He is appointed by us on his pledge to give purchasers the best of every service. On Adler-Royal, you get the guarantee of a high-class dealer to back up ours.

ADLER MANUFACTURING COMPANY, Inc.
General Sales Office: Dept. C3, 881 Broadway, New York City
Factories: Louisville, Ky.

ADLER-ROYAL

Phonograph and Radio

ADLER-ROYAL NEUTRODYNE

Model 199 Table Type used with dry cells. Batteries concealed in cabinet. 5 tubes (199), Cabinets walnut or mahogany. Price $165.

Licensed by Independent Radio Manufacturers Inc. NEUTRODYNE Reg U.S. Pat Off. Pat March 27 1923 and April 1, 1924 Hazeltine Pats. Nos 1,450,080 and 1,489,228 Other Patents Pending

Send this coupon to-day for your free copy of Adler-Royal Book and Log

ADLER MANUFACTURING COMPANY
Dept. C3, 881 Broadway, New York City

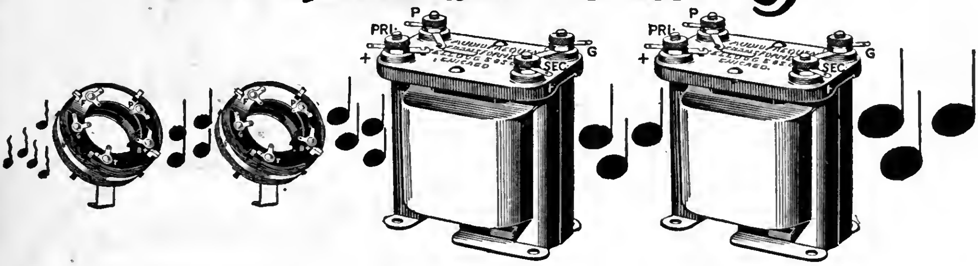
Please send me my copy of the Adler-Royal Book and Log.

Name..

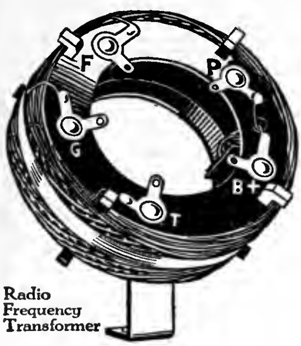
Address.......................................

★ Tested and approved by RADIO BROADCAST ★

Volume and Clarity



with Kellogg Transformers



Radio Frequency Transformer

A Radio Frequency Transformer of the aperiodic type suitable for all sets with which tuned radio frequency is desired. Also used for one stage of radio frequency amplification ahead of regenerative sets to prevent re-radiation.

Consider these points of superiority:

No dope to hold windings in place.
Soldered connections.
Mounting bracket holds coil at correct angle.
Minimum rubber used in form.
Lowest possible loss, with greatest transfer of energy.
Works with any .0005 condenser.
Secondary arranged with suitable taps for biasing features.

This transformer makes the construction of a radio frequency set an easy matter, assuring best possible reception with widely varying types of circuits, including reflex.

Built and guaranteed by Kellogg Switchboard and Supply Co.

No. 602 Radio Frequency Transformer at your dealers for $2.35 each.

Kellogg Audio Frequency Transformers are the "stepping stones" of modern amplification.

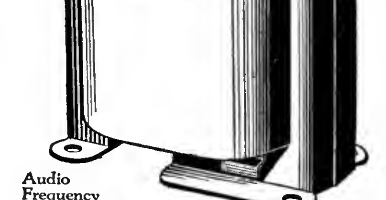
Clear, accurate reproduction assured over the entire range of the musical scale.

Plainly marked, accessible terminals.

It is acclaimed by test to be the best.

No. 501 Audio Frequency Transformer Ratio 4½ to 1—
No. 502 Audio Frequency Transformer Ratio 3 to 1—
$4.50 each

★

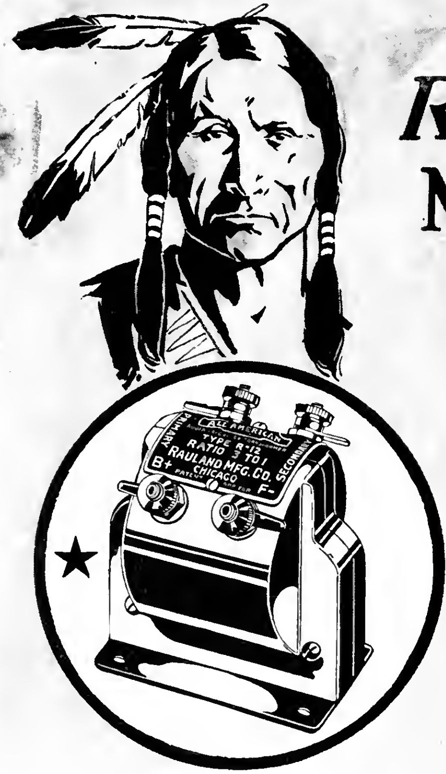


Audio Frequency Transformer

KELLOGG SWITCHBOARD & SUPPLY CO.

1066 WEST ADAMS STREET, CHICAGO

★ Tested and approved by RADIO BROADCAST ★



What *Reliable Radio* Means to You

ALL-AMERICAN Guaranteed Radio Products

Standard Audio Transformers
3 to 1 Ratio, type R-12...$4.50
5 to 1 Ratio, type R-21... 4.75
10 to 1 Ratio, type R-13... 4.75

Power Amplifying Transformers (Push-Pull)
Input type R-30.........$6.00
Output type R-31........ 6.00

Rauland-Lyric
A laboratory grade audio transformer for music lovers. R-500.....$9.00

Universal Coupler
Antenna coupler or tuned r. f. transformer. R-140......$4.00

Self-Tuned R. F. Transformer
Wound to suit the tube. R-199 $5.00. R-201A $5.00

Long Wave Transformer (Intermediate Frequency)
(15-75 kc.) R-110.........$6.00

10,000 Meter (30 kc.) Transformer
Tuned type (filter or input). R-120..$6.00

Radio Frequency Coupler
(Oscillator Coupler). R-130 $5.00

Super-Fine Parts
Consisting of three R-110's, one R-120 and one R-130.... $26.00

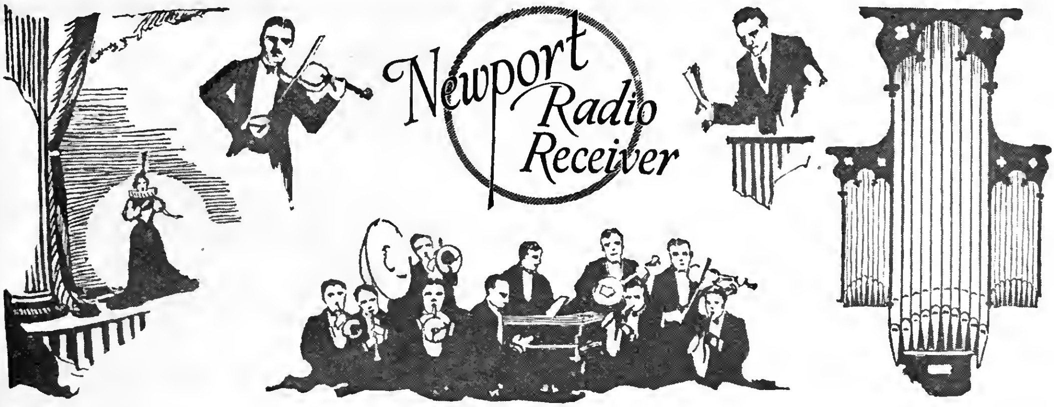
All-American Reflex Receivers
(Mounted but not wired)
All-Amax Junior (1-tube) $22.00
All-Amax Senior (three-tube) $42.00

AN assurance that, when you try out a hook-up, you can rely on your instruments to give you a *fair test*. ¶ A knowledge that each part has been put to such searching tests that its proper performance, *under any conditions*, is assured. ¶ In short, a conviction that each individual part *will continue* to do its work *year after year*.

The RADIO KEY BOOK will acquaint you with the essential facts of modern reception. Ten cents—coin or stamps—brings the KEY BOOK

RAULAND MFG. CO.
Pioneers in the Industry
2652 Coyne St. Chicago

ALL-AMERICAN
Largest Selling Transformers in the World



Newport Owners Know What Tonal Quality is!

The Tonal Quality of the Newport brings to them the ineffable thrill of good music.

They have experienced those delightful little runs, fine gradations, and double stop work in Kreisler's "Caprice Viennois" which are so clear, well defined, and ungarbled in the Newport. The thunder of the organ as it runs the gamut of its mighty diapason is not new to them. They parade across the theatres of their minds every evening all the brilliance and charm of the virtuosi. They catch with ease those slight inflections of the voice that often mean so much when famous men speak. They make their Newports perform the acid test of Tonal Quality. They dial into the militant swing of Sousa's "El Capitan" or the "Stars and Stripes Forever." That they can distinguish the high trebles, the deep bass, the various instruments that go to make the action-stirring whole of this famous orchestration, is not novel to them.

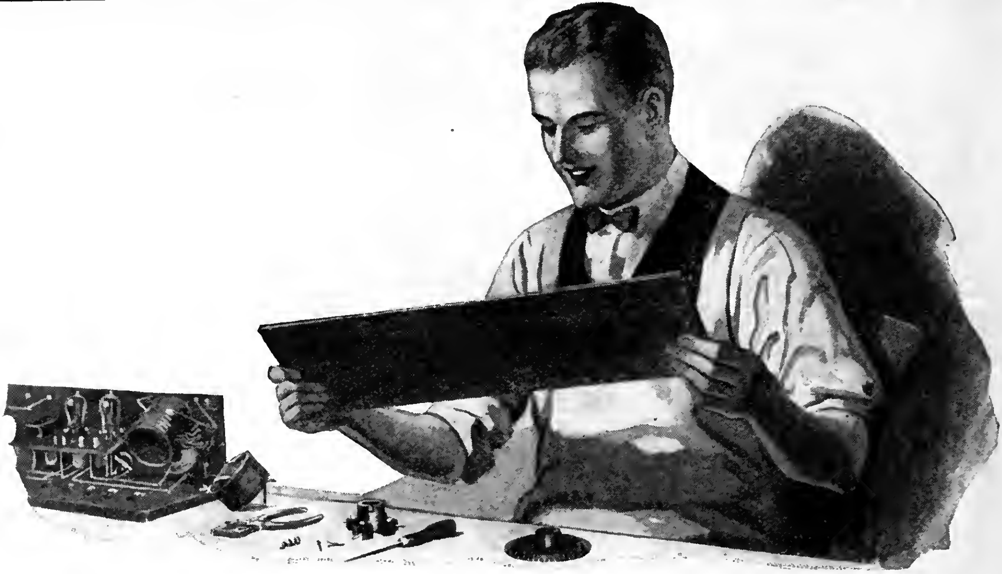
They know what Tonal Quality is!

The Newport is a Good Receiver
Built in a Piece of Fine Furniture

★ *Newport Radio Corp.*

250 West 54th Street,
New York City

★ Tested and approved by RADIO BROADCAST ★



Notice the rich finish on this panel —*built to order for radio*

A SURFACE that is good-looking and useful, too. That was one of the demands we made of the engineers who developed Radion especially *to order* for Radio purposes.

The high-polished, satin-like finish of Radion Panels does more than add to the beauty of your set. It keeps out dirt and moisture, thus preventing the possibility of causing short circuits from this source and reducing good reception.

Lowest losses and greater efficiency

But the worth of Radion is not just on the surface. Authoritative laboratory tests give it the highest rating as radio-frequency insulation. It reduces surface leakage and leakage noises. This means lowest losses and greater efficiency, especially noticeable in super-sensitive circuits.

Radion Panels resist warping. It's the easiest material to cut, saw or drill. It comes in eight stock sizes and two kinds, Black and Mahoganite.

Better performance will make it worth your while to ask for Radion by name and to look for the stamp on the panel and the name on the envelope. Radio dealers have the exact size you want for your set.

Other Radion Products

The same qualities of low-loss insulation and attractive appearance characterize Radion dials (to match panel), binding post panels, insulators, knobs, etc.—also the new Radion Built-in horn.

Send for booklet "Building Your Own Set"

Our new booklet, "Building Your Own Set," giving wiring diagrams, front and rear views, showing a new set with slanting panel, sets with the new Radion built-in horn, lists of parts and directions for building the most popular circuits —mailed for ten cents. Mail coupon to-day.

AMERICAN HARD RUBBER COMPANY, Dept. C-3, 11 Mercer St., New York City
Chicago Office: Conway Building
Pacific Coast Agent: Goodyear Rubber Co., San Francisco—Portland

RADION ★

The Supreme Insulation

PANELS

Dials, Sockets, Binding Post Panels, etc.

AMERICAN HARD RUBBER COMPANY
Dept. C-3, 11 Mercer St., New York City

Please send me your new booklet, "Building Your Own Set" for which I enclose 10 cents (stamps or coin.)

Name..

Address..

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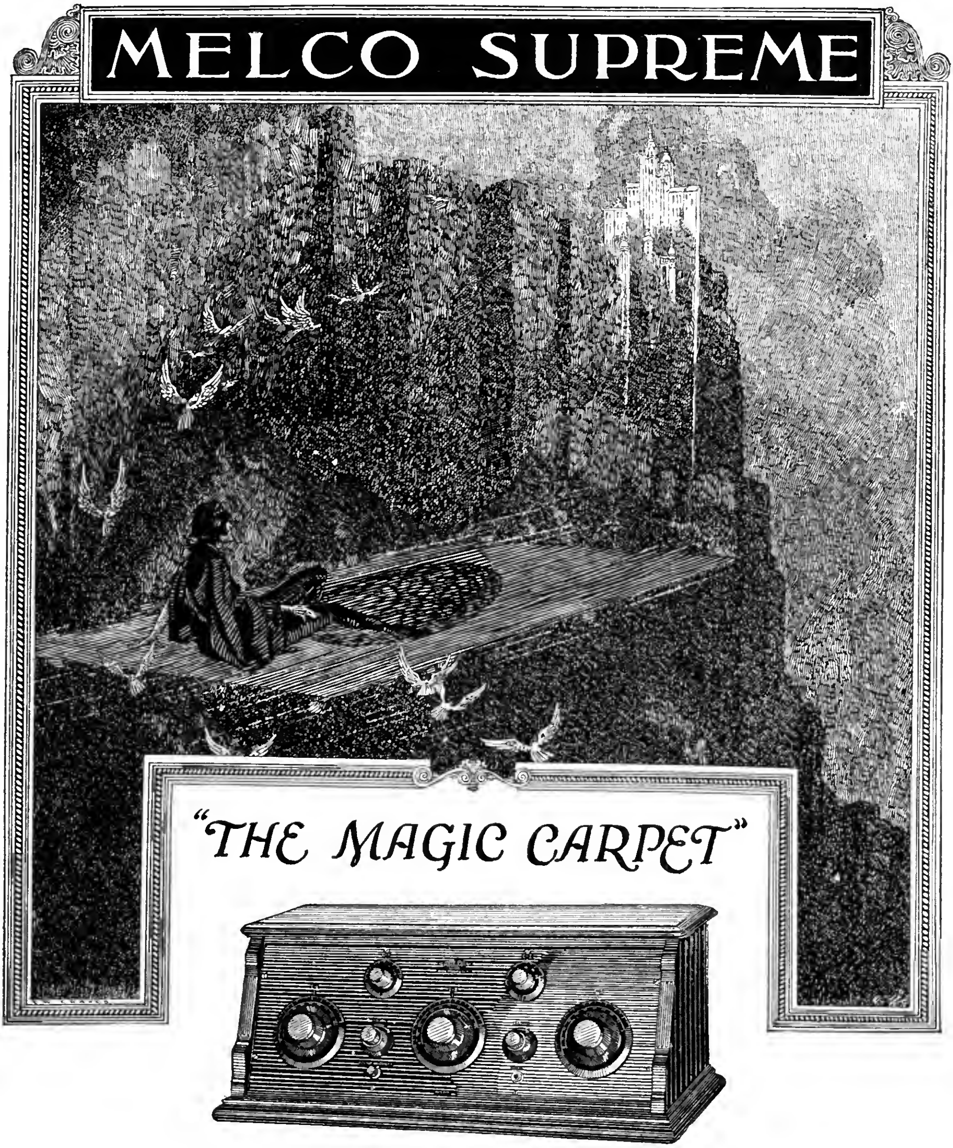

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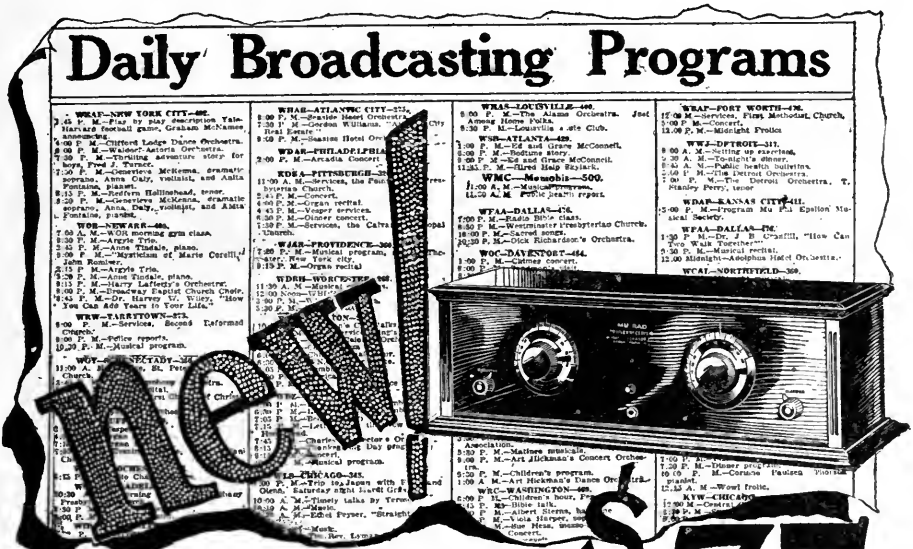

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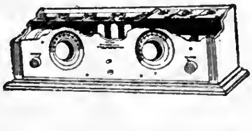

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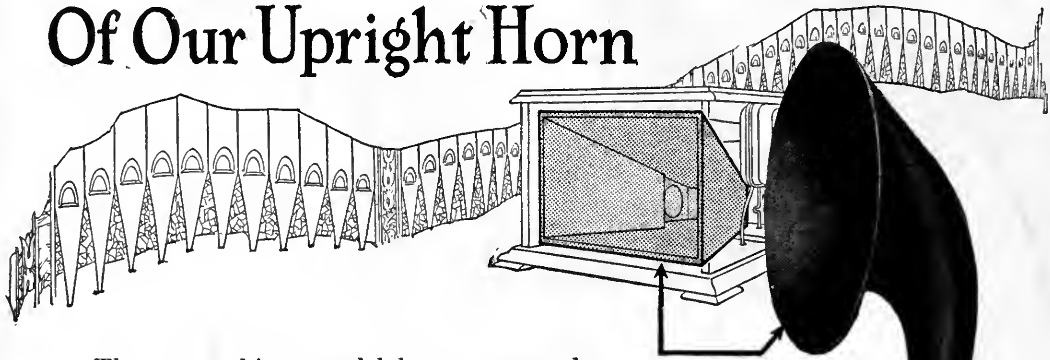

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The Bristol Company *Waterbury, Connecticut*

FOR 36 YEARS MAKERS OF BRISTOL'S RECORDING INSTRUMENTS

Ask Any Technical Engineer

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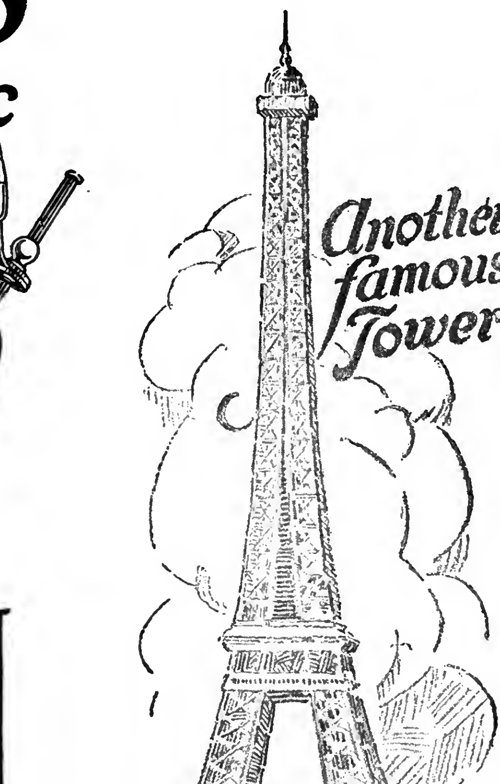

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As the Eiffel Tower stands as a monument to skilled engineering construction so TOWER'S Scientific phones stand as a monument to supreme radio achievement. ¶ Each phone is carefully tested and approved before it leaves the factory by a Government Licensed Radio Operator thus guaranteeing perfection in tone quality with a positive uniformity of volume.

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The World's Greatest Headset Value

Radio Broadcast

ARTHUR H. LYNCH, EDITOR

MARCH, 1925

TERMS: $4.00 a year; single copies 35 cents.

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THE PRINCIPALS IN A BIT OF HISTORIC BROADCASTING

The top photograph was taken in the studio of WEAF, *New York, on the evening of January 1 when two recording artists of the Victor Talking Machine Company, broadcast through a chain of eight stations. The Victor Company, through its New Year's night broadcasting, is the latest of the large phonograph companies to allow its stars to broadcast. Several weeks before, the Brunswick Company allowed a number of its own recording artists, members of the Metropolitan Opera Company, to broadcast. Calvin Childs of the Victor Company, Lucrezia Bori of the Metropolitan Opera Company, Gwendolyn McCormack, (daughter of John McCormack), and John McCormack are in the upper photograph. The insert shows Graham McNamee who capably announced the event*

RADIO BROADCAST

Vol. 6, No. 5 March, 1925

New Fields for Radio

The Next Will Be a "War in the Air"—A Consideration of the Possibilities that Radio Has Brought About

BY D. C. WILKERSON

IT WAS almost inevitable that such an art as radio—for so is the science of radio now classified—with so many new and undeveloped channels for expression, would carve a way into the rank of indispensable resources for national protection and aggression.

In the late World War, the pressure of combat was so tremendous and immediate that a leisurely investigation of the possibilities of radio was impossible, and it was only during the latter days of the war that the full measure of its advantages were practically realized.

At the beginning, there were few vacuum tubes in use by either of the Allied or Central Power field or naval forces. This De Forest invention had not received the attention nor had it been developed enough through experiment to make it a worth-while adjunct to military intelligence. The two-electrode Fleming valve up to 1914 had enjoyed considerable vogue, but it was unstable, and was regarded more as a laboratory toy than a practicable work-a-day device.

The French, Italian, German, and English electrical engineers, under the incessant demands for better and more reliable means for establishing and maintaining radio communication in the surges and stress of the battle front, started developing the vacuum tube with a vengeance, and by the time that the United States entered the war in 1917, had covered considerable ground in the development of the vacuum tube. Parallel with foreign efforts in this direction, the Western Electric, General Electric, Westinghouse, De Forest, and Bell Telephone engineers were beginning to produce real results with the three-element tube and they had made for the United States Government a fairly stable and reliable product.

—Photograph Courtesy U. S. Air Service

CLUMSY AËRIAL ELEPHANTS

Such as this "blimp" will be easy prey for the radio-controlled airplane, equipped with incendiary bombs or bullets

The vigorous plunge of our forces into the front line trenches rekindled the enthusiasm of

the Allies, and the liaison established between the practical engineers of the above mentioned companies and those of the nations aligned against the Central Powers, brought about quick changes and some real advances.

At the close of the War, the reputation of the vacuum tube had advanced to a high plane. As a means for radio reception it had proved its excellence, and its use as an oscillator and a transmitting agent had begun in earnest. Its use as a generator enabled many of the front line engineers to "get the jump" on many a zero-hour attack by the Germans, and it also served as an excellent "scrambler" for the German attempts to maintain radio communication at the front.

Following the rapid development of the vacuum tube itself came the circuits designed to use it. Some of these were the reflex, the super-heterodyne, the super-regenerator, and the neutrodyne. All of these helped attain greater selectivity, hence a greater degree of secrecy in communication. Later, have come the circuits of Meissner, the junior Hammond, and Senator Marconi.

PEACE-TIME ADVANCES AID WAR

IN EVERY case where peace-time advances are being made in the radio art, that development has a place among the resources for war. For ten or twelve years a tremendous amount of laboratory and experimental work has been done toward achieving a practical control of distant mechanisms by means of radio waves. In the United States Patent Office are anywhere from two to three hundred patents all bearing on this branch of the art, and probably three or four times as many applications not yet passed upon by the government staff of experts, as patentable.

MASON M. PATRICK

Major General, United States Army, Chief of Air Service

Since the War, the great advance in the development of radio has been followed with interest by the Army Air Service. It affords a rapid and accurate means of communication between forces behind the guns, on the land, sea, and in the air. Experiments have proved that airplanes can be operated by radio without pilots on board them. *It is believed to be possible that a number of airplanes may thus be directed and controlled from a single plane or from a control station, guided on their course and that from them bombs may be dropped when the attacking plane is over its target. Aërial torpedoes may likewise be made to find their mark. While great progress has been and continues to be made in this method of distant control of war machines, there seems to be likewise a further large field for experiment in hampering or preventing the radio operation of these engines of destruction and it is possible that this may tend to a still further radio development.*

I am interested and glad to note the stimulative effect of the publication of articles and data of this character by such magazines of the excellent quality of RADIO BROADCAST.

The proposition of distant control has many peace time uses. Railroad train cab-signal and control mechanisms can be operated by means of radio. Great unit power plants located at distant points from the zone of power delivery are going to require some means of radio communication and control. Our coast-line lighthouses and beacons are going to figure in a radio control development. In the near future, the transcontinental air mail will require radio tell-tales, showing positions of mail carrying units at some central point, as the volume of business by air mail requires a more complex control and intelligence system than its present incomplete development allows. In the event of aërial passenger and freight movement of any consequence there will be an immediate need for practical intelligence and control mediums.

Certainly in time of war, the nation which is able to keep in the air, and control the flight of mechanical engines of death will be able to sway the tides of combat in its favor.

A recent dispatch from England told that the Royal Aircraft Forces there are making

great progress in the control of pilotless planes controlled by wireless waves. In the same dispatch it was stated that the launching of aërial torpedoes or "winged bombs" was being attempted and that some measure of success in control of their flight over a limited distance was accomplished.

These military developments are naturally shrouded in mystery, protected with every artifice of secrecy available. Without doubt, every modern nation is participating in experimental work of this class, for the overwhelming tactical advantage of success in this field would weigh heavy should another international war break out once more.

ARMY OFFICERS ARE SANGUINE

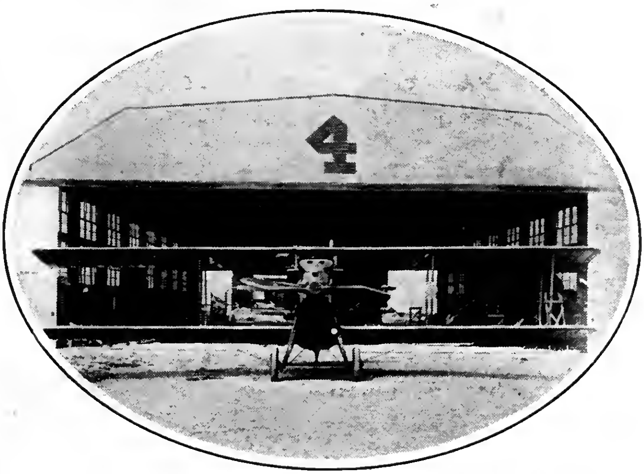
MAJOR-GENERAL MASON M. PATRICK, Chief of the U. S. Army Air Service, in an address before the Franklin Institute at the occasion of the recent celebration of the centenary of that organization stated to that distinguished assembly that the Army already had an "automatic pilot" device which flies airplanes without anyone aboard. He added that the step toward radio control was but a short one. He also said that he expected within a short time to see our military forces flying whole fleets of these planes, operated by a few men in a central control station. These fleets could be maneuvered to carry on attack against enemy cities and military units.

At the same meeting, Major-General George O. Squier, late Chief Signal Officer of the Army expressed his belief that within a short time, "manless planes" carrying sleep-producing gases sufficient to put to sleep a whole nation for forty-eight hours, could be sent into action as a means for stalemating war.

Such startling predictions by conservative military men are most worthy of consideration, but thus far none have touched upon the further developments which must follow the practical achievement of radio control of mechanical flight. The success of the radio-controlled aërial torpedo guarantees the parallel success of the radio-controlled bombing plane, the gas spreader, the reconnaisance camera plane, and the combat plane. The operating technique of the one lends itself readily to the control of the other.

With the development of lighter-than-air gases of poisonous nature, for repelling aërial reconnaisance and attack, and with the proper development of anti-aircraft barrage fire, the predicted mortality of flyers and pilots will be higher than in any previous war.

In addition to the estimated government investment loss of $25,000 for every pilot killed while flying, the lost benefits of his services amount to even larger figures. A live, trained pilot is worth considerably more than the cost of his training. The perfection of radio-controlled mechanical flight means a saving of seasoned flyers for more important uses, which cannot be furnished by automatic pilots.



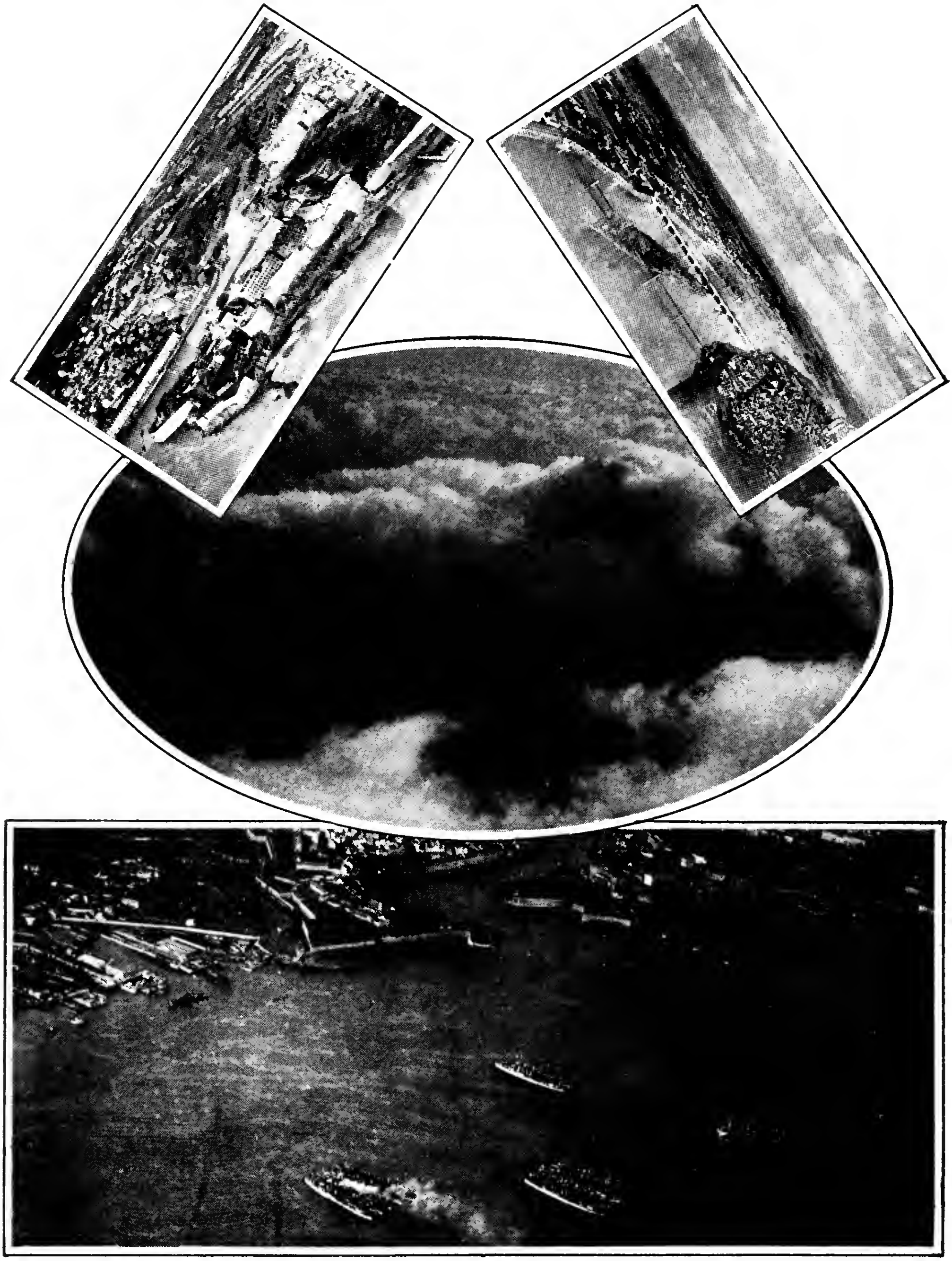
— Photograph Courtesy U. S. Air Service

WILL PLANE SUCH AS THIS, RADIO-CONTROLLED, MAKE FRONT LINE TRENCHES UNTENABLE?

Entirely aside from the Army developments, the Navy is working with radio-control. The Navy needs the automatic pilot and the controlled-flight airplane for a hundred different purposes.

WHAT THE NAVY NEEDS

IT WILL have to protect its battleship and battle cruiser fleet without which there are no bases from which to conduct flights. It will have to produce aërial smoke-screens, to conduct raids against attacking lighter-than-air and heavier-than-air bombing fleets, and to serve as the extended "eyes" of the fleet, to guarantee against inefficient position maneuvering. The latter can prove very disastrous, as the battle of Jutland so clearly demonstrated.



—Photographs Courtesy U. S. Air Service

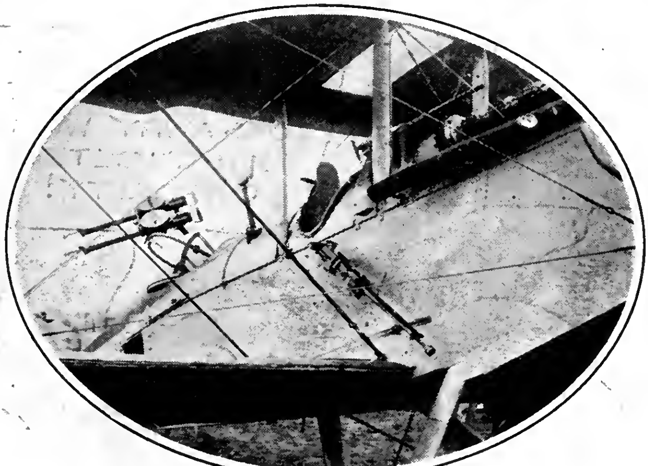
CLOUD BANKS CAN HOLD NO TERRORS FOR THE RADIO-CONTROLLED PLANE

The radio-controlled camera plane could be utilized to take aërial photographs such as these and return them safely to headquarters with valuable data on enemy forces. These shown here were all taken in the regular manner by the Army Air Service photographers in France during the War

Radio-controlled mechanism can be called on to conduct underwater attack, to maneuver torpedoes to their destination, and to make whole mine fields "live", when, for instance, a fleet retreat is required to be "covered," by newly sown mines.

Another new use of the radio control mechanism will be its application in penetrating enemy mine fields. During the late war there was devised and used by the British Navy an invention known as the "paravane," or "otter gear." A ship thus equipped was able to steam right through an enemy mine field, and provided it did not strike a mine bow-on, the otter gear, swinging out from its side, armed with huge steel jaws, snipped the anchor cable of any mine encountered. The mine, then released from its anchoring weight, bobbed harmlessly to the surface, where it was detonated by watchful guards placed along the decks with rifles.

Steel underwater sharks, entirely radio-controlled, could easily be equipped with "otter gear," and can cut swaths through a mine field so that attacking ships can steam to enemy ports. An enemy zone can be placed in such condition that no enemy ships can maneuver there because of the danger from their own mines to their own ships.



—Photograph Courtesy U. S. Air Service

THE PROMISE OF A THREAT

Is dimly concealed in the armament of this airplane. It is theoretically possible to control the firing of the guns and releasing of bombs as well as to guide the flight of an airplane equipped for radio control

IMPORTANT APPLICATIONS OF RADIO CONTROL

NOT the least important among the developments hinging upon the successful completion of the distant control of mechanisms by radio, is the handling of decoy aërial fleets, and decoy battleships. It is a known fact that the British Admiralty completely fooled the German scout submarine commanders when they built facsimile copies of the superstructures of the Grand Fleet on the discarded hulls of pre-dreadnaught ships, and operating these decoy ships in waters far removed from the location of the Grand Fleet in Scapa Flow. There will always be a need for decoy vessels of the sea as well as of the air, and their operation will adapt itself quite well to radio control mechanisms. The U. S. S. *Iowa* was maneuvered by rudimentary radio control apparatus in battle evolutions three years ago.

With radio-control, it will be quite feasible to deploy great squadrons of tanks in concentrated battle front, to batter a hole in a dangerous sector.

Mechanical land mines, underground gas bombs, incendiary flares, and short-distance catapulted detonating devices containing all three of these elements lend themselves to control by radio. An occupied area about to be abandoned, can be rendered absolutely untenable for long periods of time by intermittent explosions controlled by radio from a distant point.

At recent frequent intervals, some very interesting stories of ammunition magazine explosions and disastrous fires caused by radio waves have appeared in the press. Many of the soundest scientists refuse to credit theories of that sort. People in general have ceased to wonder at the miracles of radio, and expect much greater marvels than the art to-day is capable of attaining. This blasé attitude has restrained radio progress to some degree. It may be that powerful transmitting stations, broadcasting radio waves of high frequency, can cause currents to flow in external circuits in such a way that sparks are produced of sufficient strength to do damage. However, when one considers the thousands of circuits, telephones, telegraph wires, and house-lighting, immediately adjacent to these powerful transmitting stations it is not hard to assume that

radio energy, picked up from some powerful transmitting station, would burn out such circuits, or else seriously disturb their normal operation. This does not seem to be the case, and it can be inferred, if no better proof is available, that these stories of ammunition explosions are purely imaginary.

More to the point, and far closer to realization, is the imminent completion of successful aërial flight controlled by radio and mechanical means as outlined and as noted by the authorities quoted here. Whether or not these means now being developed will find their first practical use in the arts of peace or in the arts of war remains a question that only the future can answer. We only know that the means are available, that the energies of governments and of many private individuals are being directed toward the rapid solution of the problems presented, and that so far a fair measure of success has rewarded these efforts.

The wonders and mysteries wrapped in the radio art are gradually, but nevertheless surely, being unfolded, and the hand and mind of man are making use of their solution in ever widening circles of industrial, economical, social, and military activity.

OBSERVATIONS OF THE RADIO LIFE: NO. I

Selecting a B-Battery Eliminator

What to Consider in Buying a B-Battery Subsitute—A Helpful Discussion of Moot Points of Economy, Operation, and Value

By PHIL FAY

SO MANY different kinds of current tap devices, widely varying in price and operating characteristics, have been offered the public, that a prospective purchaser, uninitiated in the technical phases of radio and electrical engineering, finds it difficult to make a choice. The usual recourse—that of consulting a friend who has one—is rarely available in the case of the current tap devices because few or none of the manufacturers have yet reached a volume of production which is very great.

To secure satisfaction, it is absolutely necessary to select a B-battery eliminator which is adapted to your particular set and power circuit. A current tap device suited for use with a three-tube set frequently gives about as good service with a five-tube receiver as a bicycle tire with a Ford car.

A further complication is added to the situation by reason of the fact that radio salesmen are not yet sufficiently experienced with these devices to make sound recommendations. If the binding post on a current tap device reads 100 volts, they unhesitatingly state that its output is 100 volts, while as a matter of fact, with some current tap devices it may vary between 40 and 275 volts, according to the set with which it is used. Hence the prospective purchaser will do well to make a little study of the subject before making an investment as large as one for the average receiving set, lest he find his purchase a liability rather than an asset.

Batteries and Battery Eliminators

The storage battery has been in use for a long time in lighting the filaments of radio receiver tubes. This secondary source of energy in fact has been used for that purpose ever since the vacuum tube was invented. More recently, however, the storage battery has been used as a source of plate potential with considerable success. The storage batteries which were used with tubes were for a long time simply those designed and used for lighting and automobile ignition purposes, but such batteries have their shortcomings. New storage cells have been designed especially for radio circuits and are to be had on the open market.

The public has heard much and so far seen little of the devices designed and sold to replace batteries. Most prospective users are timid about purchasing these devices because they are not sure that they will perform as well as batteries. Mr. Fay's article is of genuine interest and contains facts which have been found after actual test of the various methods of voltage supply for tubes.

—The Editor.

In general, there are four qualities to consider, which determine the value of a current tap device to its user. They are:

1. The degree of silence with which it operates
2. The life of rectifier tubes and their upkeep cost
3. Its adaptability to different types of receiving sets, and
4. Its safety with respect to shock and fire.

SILENCE IS GOLDEN AND DESIRABLE

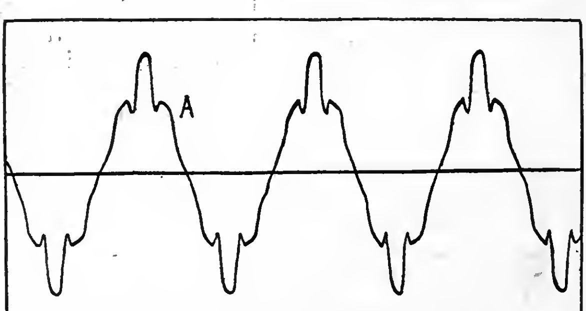
THE first quality of a current tap device which you must verify is the silence with which it operates. At first sight, this may appear to be a simple matter —a few moments of listening at a radio store. A purchaser may conclude that a certain device is silent because it was demonstrated to his satisfaction, but upon connecting it up at his home, he may find it extremely noisy. Often the dealer or manufacturer is then accused in the mind of the purchaser of having a demonstrator superior to the product sold to purchasers. But this is quite unfair to dealer and manufacturer. A current tap device which may work perfectly in one electric circuit may be entirely unsatisfactory in another because of difference in its electrical qualities. The general impression that all 110 volt 60 cycle alternating current is

electrically identical, no matter where secured, is unfortunately erroneous.

There are many differences between one power circuit and another. First, there are wide variations in voltage at different hours of the day and night ranging between 100 and 120 volts. These are not noticeable in the brilliancy of electric lights or in the operation of ordinary household equipment, largely because this apparatus unlike radio equipment, is not especially sensitive to voltage variations of this amount. In a current tap supplying a radio set line voltage differences are of the utmost importance.

Another factor, which enters into the matter of successful current tap operation in one's particular location, is the voltage wave form delivered by the generating system supplying the alternating current. The theoretical sine wave, with its smooth variations, is a laboratory product only; alternators supplying power lines have individual characteristics which cause humps of differing intensity, to occur in the voltage at harmonics of the 60 cycle frequency. Engineers state that no two generators have ever been built that have precisely the same voltage curve and that an expert can recognize the wave form of a particular generator with the same degree of accuracy that a detective identifies the criminal by his finger print.

Such variations in wave form have no effect upon the ordinary loads, such as motors and electric lights, but a vacuum tube rectifier is so highly responsive to these digressions from the sine wave, which often assume proportions larger than the voltages induced in the antenna system by strong incoming signals, that satisfactory reception with the current tap may be impossible. Consequently, one current tap device, silent when supplied from one light socket, may be objectionably noisy in another.



THE OUTPUT OF A COMMERCIAL ALTERNATOR
Installed in the average power house which furnishes the alternating current used for house lighting and power purposes

POWER TRANSFORMERS AFFECT CURRENT

ANOTHER important cause of changes in wave form are those due to saturation of the iron core of transformers placed along the line to step down the line voltage to the value required by consumers. At certain loads, this effect may accentuate harmonics to a surprising degree, while at other hours and loads, they may fall to a point where they are not annoying. Hence a discriminating purchaser will not only test a current tap in his own home but will continue it over a sufficiently extended period to make certain that it will give satisfaction at all loads and conditions of his power circuit. Because of the newness of current tap devices, many dealers are willing to permit such a test and to refund the purchase price if satisfaction is not secured in your home.

These considerations with respect to variations in power supply should not lead the reader to conclude hastily that a current tap device cannot be made to work. If it is provided with suitable adjustable inductances, capacities and resistances, its characteristics may be adapted to these constantly changing conditions.

In judging the effectiveness of a current tap device in your particular location, it is also necessary to remember that power lines are excellent conductors of currents of radio frequency, as evidenced by the successful development of antenna plugs for use in place of aerials, and the transmission of radio programs over power lines, by the "wired wireless" method.

Those who live in or adjacent to buildings having elevators or electric motors have frequently heard the annoying hum which is radiated from the power lines and picked up by the antenna system. In some cases, it is necessary to wait for the offending elevator to complete its trip before satisfactory reception, even from local stations, can be secured. When using a current tap device you make a direct connection with the power conductors supplying such elevator motors, amplifying the resulting noises through vacuum tubes and feeding them to the most sensitive circuits of your receiving set. The interfering noises from such sources are therefore tremendously increased. Every time a light is switched on and off in the building, a decided click is heard, although noise from

this source is not nearly as annoying as that from high speed motors.

DISTORTION ON HARMONICS OF POWER SUPPLY

WHEN loud speaker reception is attempted, the faint residual hum heard with the current tap device is not annoying. Usually the signals from local stations are considerably stronger than the residual hum. Quality of reception is affected only upon harmonics—that is, in the case of 60 cycle current, 120,180,240,300 cycles, and so on. At these frequencies, the volume is somewhat louder than normal because the signal is reinforced by the pulsations in the power line. Thus if a scale is played at the same intensity at the broadcasting station, your receiver will respond at the same intensity, excepting at these harmonic frequencies, which will be increased in proportion to the residual hum and the amplification applied. The difference between this distortion and that produced by a poorly designed amplifying transformer is that the resonant points in the former case are very sharp, while with the latter they are quite gradual and cover wider frequency bands.

Even the best of current tap devices, entirely satisfactory for local reception, cause considerable noise where the amplification level is raised. Since local reception is the principal use to which receiving sets are put, a slight residual hum is not serious. But as soon as the amplification level is raised for the reception of distant stations, the hum increases. When a device is demonstrated connected to a receiver, it is advisable to increase tickler coupling or filament brilliancy so that maximum amplification is obtained. This will protect you against a device which is only suitable for reception from near by high power stations.

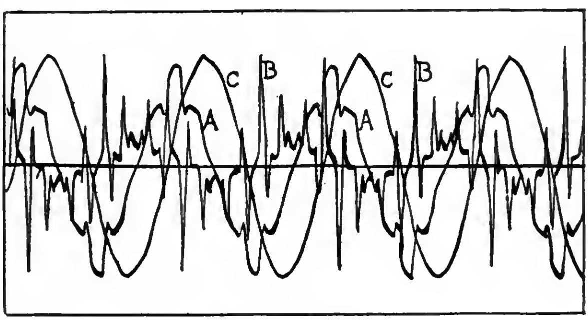
UPKEEP EXPENSE WITH THE CURRENT TAP

INASMUCH as the current tap device is purchased in order to eliminate B battery expense, the purchaser must be certain that the current tap device will prove an economy. If a current tap is suited to the load for which it is used, there is no reason why it should not be economical. On the other hand, tube renewals, with a poorly designed current tap device, may be several times the cost of B batteries of good quality and of the current capacity for your receiver.

Overloading a vacuum tube is fatal to its life. Life tests have shown that a *5 per cent. overload in filament voltage may cut in half the life of a tube,* which practically doubles the cost of maintenance. This condition can be overcome in a current tap, if means be provided to control the filament voltage of the rectifier tubes. By all means select a current tap device which is equipped with means of controlling the filament voltage, for without it economy is quite impossible. It may appear that a properly designed current tap supplies the tubes with the correct filament voltage without requiring adjustment, but this, unfortunately, is not the case.

Assume that you have a current tap designed to furnish exactly five volts to the rectifier at 110 volts of current supply. In the early evening hours when there is the heaviest drain on power supply, it is usual that the supply drops to 105 volts and consequently, the rectifier filaments are being furnished with only 4.56 volts—a considerable underload. This permits of maximum filament life. But by 10.30 P. M., the voltage of the power line is likely to increase to 120 volts, because the load upon it has decreased. It is characteristic of power systems that as the load falls the voltage increases. Consequently there are constant fluctuations in line voltage at all hours of the day and night.

At 120 volts, the filament supply is 5.45 volts, or approximately 10 per cent. overload, *sufficient with most tubes to cut their*



THE EFFECT

Of inductive and capacity loads on the regulation curve of a typical commercial power house alternator. These loads are such demands as are ordinarily made by normal power-consuming devices. The variation in voltage is clearly indicated. These varying demands result in an uneven voltage being delivered to the power-consuming device. This effect is not serious with the incandescent lamp and the usual household device, but the accompanying article shows its effect on a radio receiver using battery eliminators

life to one fourth. Hence, no matter how conscientious the manufacturer, he cannot make a current tap suitable to all conditions, unless it is equipped with a filament voltmeter and means of regulating the voltage supplied to the rectifier tube filaments. A device which works perfectly under laboratory conditions may in your service completely belie all life and silence tests. In order to increase output, many current taps are so designed that even with normal voltage the filaments are considerably overloaded and operation on increased voltages, which obtain late at night, make tube life a matter of hours instead of hundreds or thousands of hours.

OVERLOADING FILAMENTS IS EXPENSIVE

THERE is a basis which permits the elimination of certain current taps without further investigation by reason of the fact that their tube equipment is such that it is under no circumstances economical. A current tap equipped with UV-201-A tubes has a definite limit to economical output. To quote John F. Rider, a radio writer in "The Laboratory Scrap Book," New York *Sun* Radio Section, Oct. 18, 1924:

> The 201-A tube has often been recommended for the rectifying medium in B battery eliminators. Unfortunately, however, while it does function as a rectifier and may be utilized as such, its current output is so limited that its application to this type of work is very poor—that is, if one is desirous of utilizing the unit in conjunction with a multi-tube receiver.
>
> In order that the B battery eliminator may be a success, it is necessary that its current output be at least twice the total possible current drain of the tubes used in the receiver with the maximum plate voltage applied. Having both equal is impractical, as a strong signal will increase the drain beyond the normal value, and the moment the drain is in excess of the supply the voltage of the latter will undergo a considerable drop.
>
> The current output of the average 201-A tube when used as a rectifier and arranged so as to supply about 120 volts is about 20 to 22 milliamperes. With several tubes which were tested the maximum rectified current was only 18 milliamperes. In addition, it was necessary to maintain the filament brilliancy above the value specified by the manufacturer, thus greatly decreasing the life of the tube. To attempt to use a rectifying arrangement of this type with a receiver that draws 30 or more milliamperes is out of the question, hence it is necessary somehow to increase the current output of the B battery eliminator.

It may appear at first sight that the use of two tubes (as is done on practically all devices) may double the output. But indeed this is not the case, for one tube functions during one half of the cycle and the other tube during the other half. A five-tube set, for instance, may draw as high as 25 milliamperes, and consequently a supply of 18 milliamperes, which is the maximum output, even with considerable overloading, that UV-201-A tubes can be expected to deliver, it is quite out of the question that satisfactory results may be had. The total output must be at least 30 milliamperes, or else there will be distortion in the received signal.

Another type of tube which is sometimes used by experimenters, is the Tungar rectifier, familiar through its use in battery charging devices. This device is designed to supply a heavy current at low voltages. It is not a high vacuum tube but filled with a gas that is easily ionized so that it can become a conductor of considerable current. Consequently when it is used with excessive voltages it has the unstable characteristics of gas tubes and the effect on the life of the filament is disastrous.

"S" tubes do not have any of these disadvantages. However, they are designed for use with radio transmitters to deliver high voltages and small currents. A current tap made with S tubes is likely to overload the receiving set unless extraordinary precautions are used. A very high voltage is necessary to make these tubes work and it is not wise for the novice to wear headphones so intimately associated with an S tube requiring 750 volts as plate potential. Damage to the set may be repaired but ear drums are irreplaceable.

ADAPTABILITY OF THE CURRENT TAP DEVICE

SO FAR, we have seen that a current tap device must be suited to power line conditions and that the tubes must be able to supply the necessary output. These conditions can be met through the selection of a current tap device of the proper characteristics. The third condition—adaptability to your particular set—can be met in the same way. But the user must keep in mind the fact that the same device will not work with the same satisfaction with all other receivers. Inasmuch as there is a comparatively large investment involved in the purchase of a current tap, it is essential it give service over a period of years. For instance, an economical five-tube receiver used 500 hours a year can be supplied with B batteries for five years for $75.00 if heavy duty batteries be used. A current tap costing $50.00 suited to the load so

that the tubes last fully a year, would require 4 renewals at $8.00 each, or $32.00, making a total cost for equipment and tubes for five years of $82.00. Hence, assuming economical upkeep for the current tap, five years must pass before the expenditure for the eliminator becomes less than that necessary for B batteries. You must be sure that your present receiving set with the present type of tubes will satisfy your requirements for a period of at least five years. Otherwise B batteries will serve you better than a current tap device.

The reason that a B battery eliminator is not adapted to different kinds of sets is that its voltage output varies with *the load which is drawn from it.* For instance, a certain current tap device was measured under varying conditions of load, without change of the voltage in the current supply from the power mains. At 1 milliampere it furnished 180 volts of plate current; as the load increased to 15.5 milliamperes, the voltage fell to 90; at 25 milliamperes, the average drain of a five-tube set, the voltage furnished was but 40 and at 32 milliamperes, the voltage was zero. On the second stage of amplification, the voltage was too low to give the best results and the load so near the peak output that the distortion was noticeable.

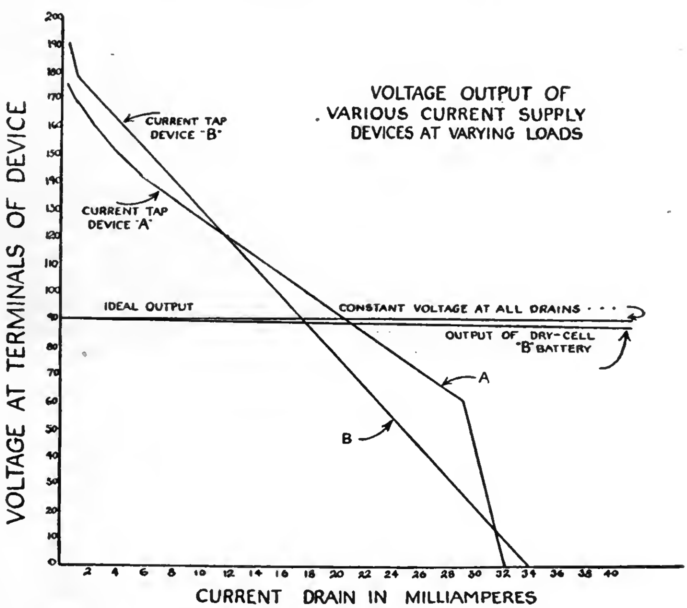
This particular device gave 100 volts plate supply at 13 milliamperes which is a good output for an economical four-tube set using UV-201-A tubes.

In selecting a current tap device, therefore, measure its voltage when supplying the plate current needed for your set. If this falls somewhat below the rated voltage of the device, select another make of current tap which is better suited to your requirements.

FACTOR OF SAFETY

NATURALLY, there is a little hesitancy on the part of those not accustomed to dealing with high power electric mains to connect a pair of headphones, directly or indirectly, with a source of kilowatts of energy. A well designed current tap device having insulated binding posts and concealed wiring, exposes its user almost to no danger, except when one turns the lighting current on and off. If you turn off the filaments of your receiving set with the current tap device still in operation, all load is of course removed from it. The output of the rectifier tubes is merely supplied to the condensers and inductances which form the filter of the current tap device and high voltages are quickly built up, unless the output terminals of the tap are short circuited by a resistance through which these voltages may leak off. Some devices are so equipped; others are not. If, after having turned off the tubes of the receiving set, your next act is to turn off the electric light switch supplying the current tap, this charge remains in the filter condenser, seeking a place to discharge. Then, if you proceed to change the wiring of your receiving set or touch the B battery binding posts, you will have an excellent opportunity to test the effect of a high voltage upon your system.

A simple precaution, however, will practically eliminate this danger. First, always turn off the current tap from the power mains *with the receiving set in operation.* Be certain that you and all the members of your family understand this. Second, short circuit the output mains, *after turning off the supply mains,* before you touch the wiring of your set. In



A CURVE

Which shows the voltage output of various current supply devices (B battery eliminators) plotted against the current drain caused by a receiver in milliamperes

this way, you will avoid the danger of shock.

Another source of danger in the current tap is fire due to overheating. Never operate a current tap device without someone in the room. When current taps were first placed on the market, life tests were made at a laboratory and one of these devices was left on all night. A fire which did several thousand dollars damage resulted. Had someone been there, warning through fusing wires would have been given in time to turn off the device.

A well designed current tap device presents none of these dangers. You can determine this for yourself by looking for the stamp "Approved by the Board of Fire Underwriters" on the device which you select. This mark appears on every piece of apparatus which has been inspected and approved by the board as safe for household use. There are scores of well-known manufacturers of household apparatus. Select a current tap made by one of these, for they have learned the results of placing unsafe apparatus on the market by painful experience.

The convenience of having plate potential always available is certainly worth a little care in the selection of a current tap device.

Satisfy yourself on these points and you will find your investment justified:

1. Is the current tap device silent when connected with *my* receiving set *in my own home?*
2. Does it use tubes capable of furnishing the current which *my set* requires with economy in tube renewal?
3. Is there means of regulating the voltage input of the device so as to compensate for the variations in power supply?
4. What voltage does the current tap device supply to *my set* and is it sufficient to give good results and not too high to be a source of danger when connected with headphones?
5. Is the current tap device approved by the Board of Fire Underwriters?

RADIO PERFORMERS IN PERSON

At a children's hospital. The Radio Franks, who are well known to radio listeners went to perform in person for these crippled children, who before had only known them as voices over the air

Who Is to Pay for Broadcasting—and How

The Plan Which Won Radio Broadcast's Prize of $500 Offered for the Most Practicable and Workable Solution of a Difficult Problem

By H. D. KELLOGG, Jr.

RADIO broadcasting, to be placed on a sound economic basis, must pay its way as do other forms of entertainment. It should be paid because of, and in proportion to, the value of the entertainment provided. And the payment should be made by the consumer, that is, the owner of the receiving set.

Under present conditions, what is entertainment for the radio fan is a subtle source of advertising, in the great majority of cases, for the broadcasting station. And advertising foots the bill. This inconsistency between the purpose of the broadcaster and the radio listener, and the differential between the source of payment and the actual consumer, has led to recognition of the fact that the economic foundation for broadcasting must be rearranged.

While it is apparent that a certain proportion of the expense of present-day broadcasting can continue to be borne by appropriations for the advertising received, and that artists who wish to receive the advertising that their performances bring them will perform free, still the highest type of broadcasting cannot be financed indefinitely on this basis. To secure the utmost excellence in talent, talent which needs no advertising, the performers or artists must be paid. And further to insure that program directors shall secure the best entertainment possible, untrammeled by any commercialism or advertising for the broadcasting station, the operating expense of the station should be paid directly by the radio audience.

H. D. KELLOGG, JR.

Of Haverford, Pennsylvania, winner of Radio Broadcast's $500 Prize Contest. A tax of $2 on each tube and $.50 on each crystal used in a receiver is proposed by this plan, and the funds so raised to be administered by a Federal Bureau of Broadcasting

A YEARLY CHARGE—TO THE RECEIVER

A CHARGE, then, must be collected from each owner of a radio set, on a yearly basis, sufficient to pay the annual expense of the broadcasting received. The fair and equitable way to apportion the sum each owner shall pay is on the basis of the value and range of his set and the amount it is used. We would not expect the owner of a crystal set with its limited range and sensitivity to pay as much to the broadcasting fund as the owner of a many tube super-heterodyne.

The amount paid by the radio owner should be compulsory—in other words, it should be the equivalent of a box office charge. No theatre could support the cost of regular performances open to the public in a sound and business-like way through voluntary contributions. A fixed and definite amount must be collected from each individual in the audi-

ence before entering the theatre. And likewise the owner of a radio receiving set, with his power to tap in on many sources of entertainment, should be made to pay his share of the entertainment received, commensurate with the range of his set and the amount it is used.

Probably the best index of the range and cost of a set lies in the kind and number of its tubes. In a crystal set it is difficult to pick out any one satisfactory index of its value or use. The crystal should no doubt be taken as the index here. A charge, then, on the tubes or crystals purchased, and included in the purchase price paid by the owner of the receiving set, is the method here suggested for meeting the cost of broadcasting. Why these articles rather than any other should be taken as the criterion in laying the charge will appear from what follows.

THE TUBE IS THE INDEX OF THE SET

IF EXCEPTIONAL cases be excluded, it may be said that the tubes used in receiving sets to-day have a life closely commensurate with the service they render. Two similar tubes giving identically the same service may not last each as long as the other. But in the long run, tubes of reputable manufacture in ordinary service will last a time closely enough concurrent with their usage to serve as a basis for the owner's share of the broadcasting he receives.

With crystals the relation between use and useful life is not so satisfactory. Crystals do in time lose their sensitivity as detectors and have to be discarded. But statistics will be needed to determine accurately how long the different crystals now in use for radio reception may be expected to give satisfactory service before requiring replacement. No doubt considerable data on this subject is already available. Although this mode of guaging "broadcasting consumption" for this type of set, which it is believed involves the majority of receiving sets of to-day, is not wholly satisfactory, still no better criterion is apparently available.

In a tube set, the number of tubes is an excellent index of the cost of the set and of the range over which it can receive. Thus a broadcasting tax on tubes will affect more the owner of the expensive set who should be required to pay more, because he is able to command a broader choice of program than the owner of the less expensive set, who is correspondingly less able to pay the larger tax. Crystal sets do not as a rule involve very expensive equipment and in any event their range is usually limited, and hence a sliding tax scale here is not particularly to be desired.

A Summary of the Plan

I. Radio broadcasting must pay its way.

II. Person who must pay is the consumer—the radio listener.

III. Most satisfactory mode of payment is a definite charge applied to every owner of a receiving set in proportion to range, value and amount of use of set.

IV. This charge must be compulsory—a "box office" charge.

V. The best index of the range and value of a set lies in the kind and number of its tubes. In a crystal set, the crystal is the best apparent index.
   - A. Life of tubes and crystals represents with reasonable accuracy the amount of use set has.
   - B. Number of tubes is index of diversity of broadcasting programs at consumer's disposal.
   - C. Levy can be readily applied to tubes or crystals in form of stamp tax collected from manufacturer and paid by final purchaser.
   - D. Apportionment of tax greatly simplified and evasion minimized.

VI. Yearly tax not excessive and should not harm the industry.

VII. Only possible administrator of the super-broadcasting fund is the Federal Government.
   - A. Problem national in scope.
   - B. Private interests would require monopolistic powers.
   - C. Administration of broadcasting fund not particularly liable to political corruption.
   - D. Importance to Government of controlling broadcasting stations as means of directing public opinion.

VIII. Concrete illustration shows how $18,000,000 a year may be raised by stamp tax for super-broadcasting purposes.

IX. Government will take over some existing stations and build others by bond issues amortized from broadcasting fund. Immediate fund obtained by collecting tax from sets now in use.

X. Conclusion that super-broadcasting for, and paid by, the consumer places broadcasting on its rightful basis.

A TUBE TAX IS READILY APPLIED

THE most important feature of a broadcasting levy applied to tubes and crystals is the readiness with which it can be applied. A stamp affixed to the article, or applied as a seal to the package by the manufacturer lends itself to the requirements of a strict enforcement measure. A concurrent feature is that the work of supervision and apportionment of the tax is greatly simplified. It is difficult to apply a tax to a radio set, which may consist of antenna, ground, batteries, amplifier, loud speaker, and innumerable other components or accessories. To levy a tax on all of these articles would be a clerical task of unnecessary magnitude that would make the expense of collection excessively high.

Since the manufacturers of tubes is so nearly a monopoly, under the existing patents on these important products of the radio industry "bootleg" manufacturing or evasion of the tax would be difficult. Conversely, the tax on tubes would be simple and easy of application and enforcement. With crystals, however, the situation is not so simple. The production of these articles might be made into a monopoly, thus facilitating the application of the stamp tax at the point of manufacture. Or a few large wholesaling houses might be given control of the entire supply and the stamp tax applied there. It is not inconceivable that the requirement be laid down for the affixing of a stamp representing the tax at the time of sale to the ultimate consumer. But a tax collected from the manufacturer, provided there are not too many manufacturers, could be more readily enforced and is therefore most desirable.

The effect of a tax as outlined upon the radio industry is problematical. It would depend largely upon the additional cost of tubes and crystals to radio fans. In a later paragraph, the yearly budget needed for broadcasting purposes is briefly discussed, and the amount required from each owner of a receiving set does not seem excessive. The economic stability accorded to broadcasting by the plan outlined should soon carry the industry farther forward than ever before.

Is This the Solution?

This plan of Mr. Kellogg's, which received the prize of $500 offered by RADIO BROADCAST, won over some thousand others which were submitted. The judges were, Professor J. H. Morecroft, president of the Institute of Radio Engineers (1923–4); Major J. Andrew White, formerly editor of the *Wireless Age* and well-known descriptive broadcaster; Harry Chandler, publisher of the Los Angeles *Times* and owner of KHJ; Frank Reichmann, a Chicago radio manufacturer and an old-timer in the field; Dr. Royal S. Copeland, United States Senator from New York, representing the public point of view; A. S. Lindstrom, chairman of the Pacific Radio Trade Association; Zeh Bouck, one of the best known radio authors in America; and Charles H. Porter, Chicago, secretary of the Radio Manufacturers' Association.

The officials of the American Radio Association, under whose auspices the contest was conducted, do not feel that this plan is the final word in the matter of "who is to pay?" and neither do the editors of this magazine. The broadcasting problem cannot be settled as easily as this plan proposes, although without doubt there is much to be said for Mr. Kellogg's plan. One of the chief stumbling blocks is the setting up of a federal bureau of broadcasting which seems to be contrary to the entire trend of radio development. We believe that anything which smacks of too centralized federal control or censorship would be resisted as much by the public as by all those administering radio to-day. Next month we shall print an interesting discussion on the entire subject.

—THE EDITOR.

THE GOVERNMENT SHOULD ADMINISTER THE FUND

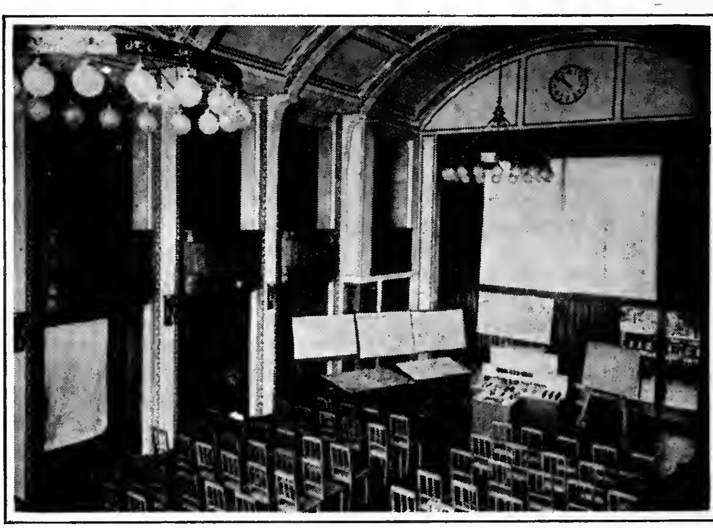
THE most practicable administrator of the broadcasting levy outlined is obviously the Federal Government. It is inconceivable to require manufacturers and producers of tubes and crystals to collect a stamp tax and turn it into a pool or fund held as a monopoly for and by private interests. The problem is clearly national in scope. It is outside the control of individual states and if run by private interests would require the granting of dangerous monopolistic power. The work of administering a national broadcasting service is not particularly susceptible to political corruption. With full publicity of all accounts, mishandling of the funds in trust would certainly be difficult. And the public would be a daily judge of the quality of entertainment provided. The tremendous value to the Government of having broadcasting stations continuously under its control in times of

emergency, or even in ordinary times, to crystallize and direct public opinion and thought, cannot be overemphasized.

Broadcasting under this plan would then be conducted from twenty-five or fifty high power stations throughout the country. How these may be financed can be indicated by a brief illustration. Tubes and crystals should be rated according to their quality, durability and service. A stamp purchased from the Government Division of Broadcasting should be affixed by the manufacturer to the article or its container. The amount of the stamp should be set, in accordance with statistics compiled, such that each tube will bear $2 of the broadcasting budget for the year. Similarly, the tax on each crystal sold may be apportioned so that each crystal will bear 50 cents of the broadcasting budget for the year. If we assume 4,000,000 tube sets with an average of two tubes each and 6,000,000 crystal sets in operation, the returns from taxes set at this rate would be $19,000,000. Taking $1,000,000. as the cost of collection, $18,000,000. would remain to be distributed among some twenty-five or fifty stations, allowing each $720,000 or $450,000 respectively, per year.

It will no doubt be found desirable, in installing super-broadcasting, to take over many existing stations, though no attempt should be made to prevent present stations from broadcasting on the same basis as heretofore. New stations which may later be installed can be financed by bond issue amortized from the general broadcasting fund. A sizeable amount of the initial expense of taking over existing stations can conceivably be collected from the present owners of receiving sets as a retroactive inclusion under the collection of the stamp tax on later sales, though the payment could not be enforced without popular support. This would greatly hasten the advent of super-broadcasting, however, which otherwise would have to wait for sufficient accumulation of returns for the normal sales of tubes and crystals before it could be instituted.

It should be understood that while super-broadcasting will place before the public daily, the best talent, entertainment, lectures and concerts available, in a way that is now largely impossible, still the payments to artists for broadcasting service should not be as high as for public performances. There is not the expense involved for the performers in the broadcasting of a concert, either at the time of a public performance or at other times, that accrues for the public performance alone. In the case of many lectures or addresses, the only expense should be that of transmission. The important feature of super-broadcasting paid by the radio listener-in is that it places broadcasting on the firm foundation of direct, paid service to the consumer and insures every day the best possible programs from well-equipped stations, unencumbered by advertising or other irrelevant considerations.



THE LARGEST GERMAN RADIO STUDIO
At Nauen, near Berlin

"As the Broadcaster Sees It"

BY CARL DREHER

Drawings by Franklyn Stratford

The Rising Tide of Microphones

WE ARE proud to present the first article in Mr. Dreher's series, "As the Broadcaster Sees It." For some time the great number of engineers and others interested and responsible for broadcasting have needed a place where their problems could be presented and discussed—perhaps even solved. The broadcasting field is getting so large and varied that intelligent comment, help, and suggestion should be of great interest to those in the field, those who are thinking of entering it, and those who are simply watching from the outside. The listening public will discover that Mr. Dreher has gathered together information which is highly interesting and essentially worth reading and also presents criticism of great value. The series will not be too technical nor too popular. We hope this series sets up some sympathetic oscillations among our readers.—THE EDITOR.

IN BROADCASTING a speaker from a public auditorium, how high should the microphones be placed? It is a grave question, my masters.

The accompanying photograph, showing President Coolidge delivering an address in Baltimore, is an extreme case. The two microphones were placed almost head-high, and must have obstructed the view of many persons in the space below the speakers' stand. From the broadcaster's angle the situation is an ideal one. It is possible to obtain decidedly better quality and naturalness of speech, in the case of a quiet and restrained orator like the President, with the microphones at head-level and fairly close to the speaker's lips. In this way the higher tones of the voice, the harmonics which are so important in the production of consonant sounds and delicate inflections, but whose energy is comparatively small, are retained and passed on to the amplifiers. These higher frequencies are easily lost. Generally speaking, with the microphones waist-high, quality of transmission will be slightly inferior. A fair compromise would seem to be at about the level of the speakers' chests. The pick-up is good enough for all practical purposes, and there is no interference with a clear view of the face of the man on the platform. Both the physically present part of the audience and the radio listening portion will be satisfied.

IDEAL PLACING FOR THE MICROPHONE

Few broadcasters are able to arrange as favorable a placing of the microphone as was arranged for this speech of President Coolidge. Where the microphone is so favorably placed, excellent speech quality results

The opposite extreme to the case discussed above is in theatrical broadcasting. Usually the only pick-up permissible is in the footlights, ankle-high. The speakers are distant from the mi-

the rising tide of microphones

crophones, and they move around as they talk. To obtain perfect quality under these conditions is out of the question; to do a reasonably good job is an achievement. In spite of the transmission difficulties, broadcasting from the stage is one of the most popular program features that a station can handle. The prerequisite, however, is careful selection of the shows to be broadcast. Generally speaking, the more music the play contains, and the less dialogue, the better it will broadcast. But the engineers will never be really happy, in broadcasting from the stage, until microphones the size of a dime, suspended on No. 30 steel wires, can be placed all over the proscenium. And we are a long way from that, with high quality microphones $3\frac{1}{2}$ inches in diameter, and weighing $2\frac{1}{2}$ pounds apiece, without the housings. We may admire, without attempting to emulate, the bold Baltimore broadcasters who set their transmitters before Mr. Coolidge's nose, and we may pray to be delivered from pick-ups where nothing is seen—and little heard.

Radio Transmitters for All

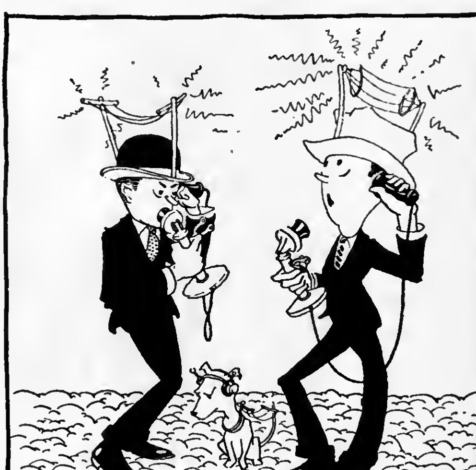
A FAVORITE subject of newspaper writers and cartoonists and prophets in general is the coming day when radio telephone transmitters will be carried about, as umbrellas are now. Portable sets like these will make possible continuous communication between individuals, and release them from dependence on restricted means of contact at a distance like the present-day wire telephone and telegraph. An example of this type of prophecy is the following excerpt from a recent editorial in the New York *Journal:*

". . . This writer has received . . . an excellent little receiving set contained in a matchbox. Using that set as a receiver, President Coolidge's speech was heard distinctly. Soon each man's hat will contain an apparatus enabling him to talk to his wife at home—an excellent thing if it helps his wife to keep track of him."

Leaving out of consideration the moot point brought up by the last clause in this quotation, we may point out that the whole contingency is very remote. The popularization of radio *reception*, and the development of highly sensitive portable *receivers*, have led many people to forget (if they ever knew) that there is a fundamental difference between transmitters and receivers. The receiver is a low-power apparatus, in the same class as a microscope or the human ear. Dealing only with small amounts of energy, it may in special forms be made small and inconspicuous. But a transmitter, in all known systems of radio, is power equipment, in the same class as a subway train or a rock crusher. In general, power means size.

Take the present 500-watt broadcasting equipment used by Class B broadcasting stations. The power of these sets is none too great for effective program distribution in a large city. Witness the considerable "dead" and weak areas which every urban station has in its own vicinity. Yet the motor required to drive such a set is a six horse power proposition, and the total weight of the transmitting equipment would tax the strength of an elephant. Carry it in your hat, indeed!

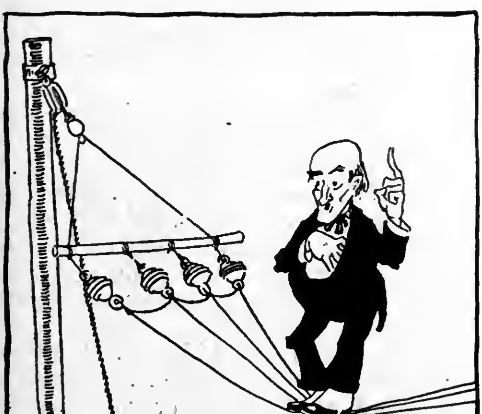
Then there is the limited traffic-carrying capacity of the luminiferous ether—bless it!—or whatever agency does carry radio messages from one place to another. The advent of



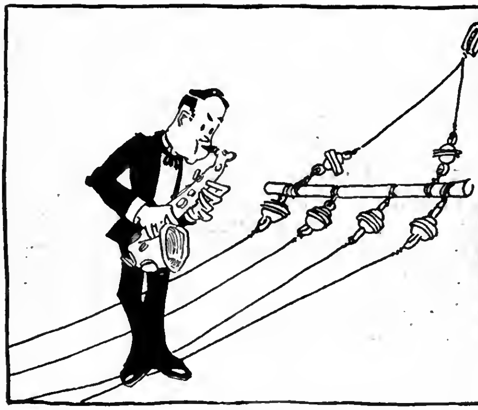
radio transmitters for all

broadcasting, as engineers know, has increased the already severe congestion in the ethereal highways. Marine radio is being forced down, amateur radio up, in the frequency scale. The art is not free from station interference in any of its branches; the problem is one which is taken up at every radio conference. What, then, would happen if every citizen got him a transmitter, when, even now, with one transmitter to about every sixty thousand persons in the United States, interference problems arise? We leave the answer to the feature writers, who are less troubled by such details than we are.

Of course, there is the development of short-wave transmission to be taken into account. Here a great supply of new wavelengths and traffic channels is opening up. And it may also be pointed out that, while power normally involves size, in the case of firearms, for example, great power is secured in very compact form by extreme concentration of force. Furthermore, radiation varies as the fourth power of the frequency, and thus one may view short wave, high frequency radio as a vaguely analogous concentration process, with the added factor that these short waves may be directed in a beam instead of being diffused in all directions. Admitting these arguments as interesting and pertinent, nevertheless, to the engineering sense, the transmitter-in-the-hat development is a thing almost as remote as the Milky Way. Universal radio communication between individuals, without the agency of corporate, public service facilities, may arrive some day, but that the communication companies, wire and wireless, will rake in dividends for a few centuries first, is a safe forecast. The development of a practical



serious speeches are broadcast



one station specializes in jazz

system of telepathy is just as probable, and telepathy is talked of glibly in much the same way, yet, to the writer's knowledge, no concrete demonstrations of the phenomenon have ever been given. It may exist, it may develop and supersede the laborious and costly forms of electrical communication which have been worked out in the last hundred years—but the vice-presidents and general managers of communication systems are not losing any sleep over that possibility. The possession by every individual of a radio *receiver*—that, of course, is another matter. That is already at hand.

The Differentiation of Broadcasting Stations

AT PRESENT all the broadcasting stations are trying to please everybody. This is not to say that all the programs are alike in point of quality, for as a matter of fact the large metropolitan stations are able to attract a better class of performers and to supplement these with out-of-the-studio broadcasting of a superior order. As yet, however, no station seems to have made a serious effort at specialization.

In the field of printed periodicals we find a great range of contents and policies, with each magazine creating its peculiar atmosphere and catering to a particular class of readers. There are the vendors of fluffy stories, the "quality magazines," critical periodicals, humorous papers, political reviews, and so on. Each is supported by a certain clientele with its special interests. Each has a reputation for presenting such and such material so and so, readers buy accordingly, writers market their

output accordingly. You can tell a man by the magazines he reads. As yet there is no corresponding development among the broadcasters. There is some tendency in that direction, but it is only a tendency as yet. One station in New York City, owned by vaudeville and moving picture interests, caters mainly to vaudeville tastes; it specializes in jazz, popular songs, dance orchestras, and the like. Two other stations, run by large public service corporations, go after dignified banquets, informative talks, symphonic concerts, and the like. Still, the latter two stations broadcast many hours a week, and when summed up it is seen that they do distribute a large amount of popular material. The similarities of the various broadcasting stations, in the matter of program material, are more marked than are their differences.

We cannot say positively that broadcasting will take the same course as magazine publishing. There are obviously economic factors involved, and the economics of the radio business are not the economics of the publishing business nor of any other business. At present, in fact, the economics of radio might be termed *sui generis*—in a class by themselves. But there is in both fields the necessity of attracting a sufficiently large audience. One cannot print a magazine for a dozen readers (except perhaps in Greenwich Village), nor can one broadcast for two hundred listeners, generally speaking. And here the question of national (super-power or chain-station) as against local broadcasting is of interest. The cost of a national or section wide broadcast distribution, whether from a single high power station or a chain of smaller stations radiating the output of a single microphone, must be so high that a very large audience is essential. The program will have to appeal to a vast army of listeners, and a proportionately wide range of tastes. The general structure may be expected to resemble that of the magazines of large circulation, and undue specialization will hardly be feasible, owing to its effect in restricting the "circulation" of the station. The smaller local stations, on the other hand, especially those in metropolitan locations, may find it advantageous to narrow and concentrate their appeal. There are probably enough radio listeners in and around cities like New York and Chicago to support a station devoted to dramatic broadcasting, say, or chamber music, or some other particular field. Such a station might broadcast only once a week, or it might be used by special interests on certain recurring days, the plant being thus fully utilized by a number of different broadcasting agencies, each with an individual cultural, political, or economic motive. It is probable that some such tendency will become more and more apparent as the art advances, and the importance of broadcasting as a medium of conveying entertainment and information is brought home to people as yet untouched by it.

Broadcasting and the SOS

SHORTLY after 5 P. M. on December 17, 1924, a steamship, sight unseen, name unknown, poked her nose into the waters of New York Harbor and called a land station with her radio transmitter. The call letters she signed were SWS, a combination which, with the changing of a single dot to a single dash, becomes SOS, the international radio distress call which takes precedence over all other human agitations of the ether on land or sea.

Whether it was a slight stuttering of the key on the part of the operator of the good ship, or a trifling inaccuracy in reading on the part of the vigilant radio electrician at NAH of the Brooklyn Navy Yard, that SWS *was* changed to an SOS. NAH blared out a general QRT which, in the radio lingo, is a peremptory summons for everybody to shut up immediately or sooner. At 5.15 all the broadcasting stations went off the air in the middle of jazz selections, market reports, interviews with celebrated bootleggers, and advice to the lovelorn. A pall of silence hung over the harbor, and telephones were pressed to thousands of pairs of cauliflower ears while thousands of auditory nerves strained to hear who was sinking and where. The suspense was broken when the SWS piped up to report that all was well and that her call was not a distress signal. NAH retired from the scene. Traffic was resumed at 5.21.

SWS is the call, according to the books, of the Greek steamer *Chelatros*. Boy, page the King of Greece and ask him whether he can't find a less delicate combination of letters for his merchant fleet. SGS, SMS, and a few others also would not be missed. Better still, why not introduce a little logic into the prevailing distress call routine, as regards taking the broadcasters off the air?

In some cases, that is a blessing. If a painless method could be found of keeping some broadcasters off the air until say, 2024, when we shall all be dead and beyond the reach of terrestrial loud speakers, that would be fine.

But there is no discrimination under the present system. Let an sos go out, or the alarm be raised that some one thinks he heard one, and all broadcasters, good and bad, are supposed to take their carriers off the air instanter. It does not matter what their wavelength is, nor where they are situated.

Actually, nothing of the kind happens. The inland broadcasters don't go off the air. I have listened during a number of Atlantic sos shutdowns, and heard about all the broadcasting stations west of the Alleghenies going full blast and modulating 120 per cent. In fact, as Professor Jansky pointed out at the Third Annual Radio Conference, most of the hinterland telephone stations don't even keep a 600-meter watch. They don't know when a ship sends out an sos, much less go off the air for it.

This may be most reprehensible, but it is none the less sensible. What chance has a 20 watt, 230 meter, peanut-roaster broadcaster in Cabbage Corners, Iowa, of interfering with the disposition of a distress call on the high seas, with all traffic relative thereto being handled on 600 meters? About as much chance as the whistle of the traffic cop on the corner of Fifth Avenue and 42nd Street, New York City.

The fact is that the present system is merely a hangover from the old marine days of radio. It has no more rationality than any other attempt to solve the radio problems of to-day with the Berne Convention of 1912. The idea was that sometime, somewhere, a broadcasting station might interfere with an sos. But the fact is that most of the broadcasters, owing to their wavelength and position, cannot conceivably interfere.

The officers of the Federal radio inspection service, have done their best under difficult conditions with insufficient appropriations. Furthermore, while the letter of the regulations covering sos calls remains unchanged at this writing, it is said that some modification of the existing system is being considered If so, this article is in line with a widespread feeling that the rules should be better adapted to present-day radio.

Of course, compared to the safeguarding of life at sea, a task which is enormously facilitated by ship-to-shore radio, broadcasting is a luxury. Better that all broadcasting should cease for an hour or two, than that the life of a single seafarer or passenger should be jeopardized. But, if the two things have no connection, or if a formula can be worked out whereby all risk of interference with sos traffic by broadcasters can be obviated, then it is nonsensical to interrupt a concert by a Chamlee or a Philharmonic Orchestra because a tramp steamer 2000 miles away has lost her rudder.

The most comprehensive scheme would be to separate the lower end of the frequency band devoted to broadcasting from the upper end of the frequency band assigned to marine traffic to such an extent that, assuming the use of decent tuning equipment, neither could interfere with the other. That will ultimately be accomplished. It will be a good thing for both services. The process is already well under way in the United States, where marine traffic has been removed from the 300 and 450 meter waves during the evening hours by regulation of the Department of Commerce.

Now, all sos calls are sent out on 600 meters. The Berne Convention provided for a 300-meter distress wave for small vessels, but in recent years no one ever heard of an sos signal on this wave, and no one listens for one. One has to look out for 600 meters only. That is one thing we know. We also know a few things about interference. We know what band of frequencies various types of tuners, from excellent to very poor, will admit. We know the effect of power on the strength of a signal. We also know the effect of distance—that the strength of the field, under the most favorable transmission conditions, apparently falls off inversely as the distance. What, then, is to stop us from developing an empirical formula which will separate the sheep from the goats, which will discriminate between stations which may conceivably interfere with sos traffic, and those which cannot possibly do so?

I have gone into the calculus and, after vast travail and figuration, brought back such a formula with me. Here it is—

$$I = \frac{(F-500)^2 \quad (100+D)}{10 \ P}$$

Where I is the sos index of the broadcasting station. When I is less than 700, the station is required to keep a 600 meter log and to go off the air on hearing an sos.

F is the frequency of the station in kilocycles.

D is the distance in kilometers from the nearest coast station handling marine traffic. This includes the Great Lakes.

P is the power in watts delivered to the antenna.

As the wavelength of the broadcasting transmitter approaches that of marine traffic

(600 meters; 500 kilocycles), I becomes very small. If F is actually 500, I will be zero, even with a power of one watt in an antenna 2000 miles from seaboard. But in general, as D increases, and as the power decreases, I becomes larger. The formula discriminates against broadcasting stations using high wavelength and high power, and which happen to be close to the oceans or the Great Lakes, since these are the ones which are apt to interfere with distress signal traffic.

The table below gives the results of the application of this formula to a number of New York City broadcasters. As D, when small, has little effect on the result, it was taken uniformly as 10 kilometers (6.2 miles) in these calculations.

SOS INDEX OF SEVEN NEW YORK CITY BROADCASTERS

STATION	WAVE-LENGTH METERS	FREQUENCY KILOCYCLES	ESTIMATED POWER WATTS	SOS INDEX
WNYC	526	570	1000	54*
WEAF	492	610	1500	89*
WJZ	455	660	750	375*
WJY	405	740	750	845
WOR	405	740	500	1267
WHN	360	833	500	2440
WGBS	316	949	500	4455

The dividing line in New York City, it will be seen, lies between WJZ and WJY, WOR, the former requiring an SOS watch, while the latter two broadcasters are absolved. The figures show the working of the formula quite clearly. With the same order of power in the antenna, and lower wavelengths, the likelihood of interference with marine traffic becomes even less and the value of the index increases sharply.

The effect of distance from deep water is illustrated in the second table:

SOS INDEX OF SEVEN INLAND BROADCASTERS

STATION	WAVE-LENGTH METERS	FRE-QUENCY KILOCY-CLES	ESTI-MATED POWER WATTS	DIST-ANCE KM.	FROM	SOS INDEX
KDKA	326	920	5000	480	Atlantic	2050
				190	Lakes	1025
WCAE	462	649	500	480	Atlantic	2575
				190	Lakes	1287
KYW	536	561	1000	10	Lakes	41*
KSD	546	549	500	820	Lakes	442*
WIP	509	589	500	60	Atlantic	253*
WWJ	516	581	500	10	Lakes	144*
KOA	323	928	1500	1300	Pacific	10000

A few remarks about the above table: KDKA and WCAE are both in Pittsburgh, Pennsylvania. KDKA's power is assumed on the basis of a Class D development license. It will be seen that in spite of KDKA's higher power, WCAE has somewhat the higher index, owing to the longer wavelength. The index was computed in the case of Pittsburgh for both the Atlantic coast and the Great Lakes.

In the case of WIP, Philadelphia, there is a question whether D should not be reckoned with reference to NAI, the Naval station in that city, rather than Tuckerton, New Jersey (WSC), the nearest marine station actually on the Atlantic. The U. S. Supervisor of Radio of the district would decide such questions.

KOA, Denver, Colorado, has the highest index of any of the stations figured. KOA could use 21.5 kw in the antenna, on 323 meters, and still keep his SOS index below the dividing line; but if he put 22.0 kw into the antenna he would have to stand a watch. No matter how low the wavelength, any one who goes up in power indefinitely will come to a point where the formula requires him to watch out for SOS calls.

The advantages of injecting order and intelligence into the SOS-shutdown situation would be twofold. First, the broadcast listeners would always be sure of entertainment from at least some of the locals, even when an SOS was abroad. That is of comparatively slight moment. What is of great moment is that with a reasonable system the law could be stringently enforced. Those broadcasters whose index numbers were below the required figure could be compelled to keep a *continuous* 600-meter watch; if, when an SOS went out, they did not go off the air, the operators should have their licenses summarily revoked. The fellows in the Middle West, or on low waves and low power anywhere, would be let alone. The present regulation, requiring two minutes listening in every fifteen, and everybody in the whole United States to shut down when an SOS is transmitted off the coast of Portugal, is ineffective, unenforced, and unenforceable; it's a joke.

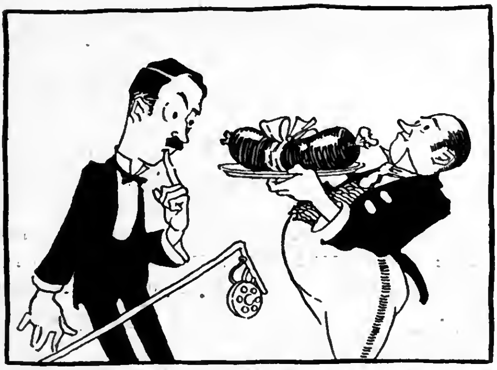
This is not to say that the mathematical formula given above is worth anything. Perhaps the mystic line of demarcation should be, not at 700, but at 500 or 900. A committee of competent radio engineers could decide that soon enough. The formula may be shot full of holes; the fact will remain that the problems of radio should be settled, not by oratory, tradition, and fiat, but by the application of engineering intelligence. A formula with an adequate security margin can be devised, just as safe values are calculated for the iron girders of a bridge. If a committee of a few

*These indices being below 700, the stations in question would be required to observe an SOS watch.

men like Dr. Alfred N. Goldsmith, Mr. John V. L. Hogan, Dr. Louis W. Austin, Prof. J. H. Morecroft, and Mr. W. D. Terrell, should devise such a formula, or any equivalent system of classification, and, being put into practice, the same should cause interference with an sos message, the writer will gladly allow his friends in the marine service to conduct him to Seagate, immerse him in the Atlantic, and hold his head under water while he recites the last four books of *Paradise Lost.*

Zoölogical Note in Report of a Field Event at WJZ

Everything O. K. except a dog barked during the announcements.



monthly prize for broadcasters

Our Announcers' Bulls Prize Contest

EACH month RADIO BROADCAST will offer a handsome prize to the announcer who makes the most original and startling bull on the air during the preceding thirty days. Many prizes have been awarded to the most virtuous, most handsome, and most popular announcers in various localities, but this is the first time in the history of broadcasting that a prize is offered for the great, glowing bulls which are constantly brought forth by members of the fraternity.

Our readers are invited to make a note of such horrible errors as come to their ears, and to send them to this department, giving station of origin and time of perpetration. All contributors whose reports are published will receive honorable mention. In case of a dispute between the announcer and the listener as to the wording of the alleged bull, or other facts, the parties in the controversy will be privileged to fight with broadswords on the Mall in Central Park, New York City, or on the tennis courts in Golden Gate Park, San Francisco, according as to which terrain is most convenient. The conductor of AS THE BROADCASTER SEES IT will referee the duel and in every case take out the survivor to dinner.

In order to guard against an overwhelming avalanche of contributions, the contest is limited, until further notice, to announcers of broadcasting stations of 500 watts power or over. We regret that the bulls of midge or mosquito broadcasters cannot receive notice at this time.

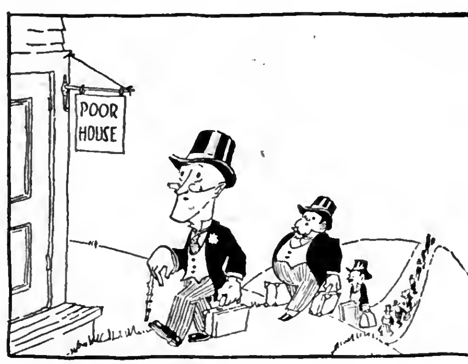
The prize for the coming month will consist of a handsome leberwurst bologna, i. e., sausage, six inches long, two inches in diameter. We look forward to spirited competition between our most popular Lotharios of the air for this desirable possession. The prize will be changed every month. For the guidance of contributors the following sample bulls, all plucked from prominent New York stations, are placed on exhibition:

One talented young man called the Philippines a principality.

The same gentleman declared that a certain soprano, who was then holding forth in his studio, had "received many commendable criticisms." Read it again if you don't get it the first time.

Another announcer released this one—"In just a moment you will have the pleasure of listening to the last number played by the Flathead Orchestra."

Open the gates, let the toreadors descend into the arena. On with the bulls!



radio amateurs at the poor house?

Those Talented Amateurs

OUR worthy contemporary, *Popular Radio,* in giving the record of a young man who is going on a trip around the world as a wireless operator, informs us that he "has been actively identified with the

American Radio Relay League, the Radio Club of America, the Institute of Radio Engineers, *and other groups of dyed-in-the-wool radio amateurs* [Italics ours].

This is terrible. We are shocked to discover that Messrs. De Forest, Elwell, Hazeltine, Marconi, and Sarnoff, to mention only a few of the Fellows of the Institute of Radio Engineers, have been working all these years for nothing, as dyed-in-the-wool amateurs. How shall they provide evening gowns for their wives, and gasoline for their Packards? Will no one take up a collection for these gentlemen, and for us, and for all the members of the Institute? Will no one organize a relief expedition to take us over the hills to the poorhouse?

Progress

In 1824, the introduction of steam railroads being proposed, many good citizens cried out in alarm, declaring that all vegetation would be destroyed along the right of way, that the passengers, whirled along at the dizzy speed of twenty miles an hour, would be unable to breathe, while persons and objects near the tracks would be swept under the wheels by the tremendous suction. Wasn't the stage coach, which had been good enough for their fathers, good enough for them? If steam carriages were introduced, they didn't know what would become of the country.

In 1924, the construction of higher powered broadcasting stations being proposed, many good citizens cried out in alarm, declaring that their receiving sets would become useless, that the local stations would be drowned out, that the ether would be monopolized, and that the radio industry, if not the Republic, would go down to ruin.

However, the viewers-with-alarm of 1924 ride behind steam locomotives, and the six remaining stage coaches are in the museums.

Item for Radio Critics

At the Metropolitan Opera performance of *Carmen* on the evening of Nov. 27, 1924, Mr. Martinelli, the Don José, tripped over his sword and fell full length; Miss Easton, singing Carmen, dropped her dagger while threatening one of the other cigarette girls; and in the third act a canvas mountain fell over and hit the gypsies.

Yet people expect radio to be perfect.

Text for Opponents of Broadcasting

And when he had opened the seventh seal, there was silence in heaven about the space of half an hour.

Revelation, 8:1.

Blame It On Radio!

VIENNA, Nov. 15 (Associated Press)—The establishment of a regular service of radio concerts and entertainments by the post office department has resulted in what is called the first case of radio insanity on record here.

A 46-year-old lithographer complained to the police that the whole world was talking about him. He said that he was connected with a radio receiver and could distinctly hear people in every part of the globe gossiping about him. He asked, pitifully, to be disconnected from the radio.

Radio had gone to his head, and he was placed in an insane asylum for observation.

—New York *Times*.

new short waves are being handed out

"I turned my desk into a radio foundry"

Radio Heaven Via the Roberts Circuit

The Cartoonist of the Philadelphia *North American* Finds Solace and Comfort in the Roberts Knockout Set—Confessions of an Artist Turned Radio Fan

By W. R. BRADFORD

"THE Roberts circuit?" asked my desk buddy: "You already have the Smith circuit, the Jones circuit, the Mack-adoo circuit, and you'll find that any old circuit by any name will squawk the same. How many circuits do you want, you octopus?"

"Only one" I replied: "But that circuit must be the one I am looking for. My constant looking for that circuit has necessitated many trips to the occulist. Listen; they say that regeneration is the equal of two stages of radio frequency. Now if one stage of r. f. can be added to regeneration, this ought nearly to equal three stages of r. f. If the howls of the lost souls that usually result from such an Old Home Week of these "Up-peppers" of radio, if these howls can be neutralized into giving the effect of a lion and lamb lying down-together why, that ought to be a ring-dingler arrangement, what?"

Desk buddy admitted it was so, but said: "Yes, but——"

"I don't care" I said: "I'll keep on running

radio hostel, and the first thing you know, I'll be entertaining an angel as a boarder, unawares."

This silenced him. It likewise silenced the other sour-grapers in the art department.

A look around in my "laboratory"—an unused corner for which no other use could be found, disclosed most of the parts necessary for the trial. Any one who has wasted as much time in radio as I have, has enough truck lying around to flotsam anything that will jetsam up in radio for many moons to come.

Back of my desk stood a five-tube tuned r. f. set which was always resorted to when the many "wonder" circuits became "duds," which was almost always. The main wonder of these wonder circuits is that we keep on falling for them, with such loud and resounding thuds. Chumps, every one of us. (Little did that r. f. set know that it was to be ousted by the Roberts circuit!)

It seemed that everybody in the building had heard of the Roberts set. At the request of all hands, I turned my desk into a radio foundry where all could get an eyeful of the proceedings:

> You can hear the snip of pliers
> As their jaws bite into wire,
> Hark! The charcoal pot is cracking—
> Solder irons are in the fire;
> But—a new condenser's needed—
> Lack of funds a stumbling block?
> No! By old Grandfather Gridleak,
> We will hock the kitchen clock!

Everybody offered suggestions, from the Big Boss, down to the window cleaners. It was clear to see that this was considered a family affair.

THE ROBERTS ON A DRAWING BOARD

ONCE stung, the wise man looks out for wasps. In consequence I first hooked up the Roberts on the back of an old drawing board. Ten minutes later I was tearing it down in feverish haste, and had started building it carefully.

I used the manufactured coils. Few of us can make such neat windings, and a sloppy looking coil is the nux vomica of radio land. However, I made a few changes in the taps of the primary coil, as follows: 17 turns of No. 22 enameled wire, with taps at turns 5, 7, 10, 13, and 17. This covered all the wavelengths I was interested in, and eliminated quite some dead end effect. I also increased the coupling between primary and secondary. It was $\frac{3}{8}''$ I made it $\frac{7}{8}''$. This made a razor-like sharpness in tuning that was as cheering as getting money from home. When you understand this set was to be used four miles from ol' woo, which has a roar like a dinosaurus, you will understand my quest for the last squeak in selectivity.

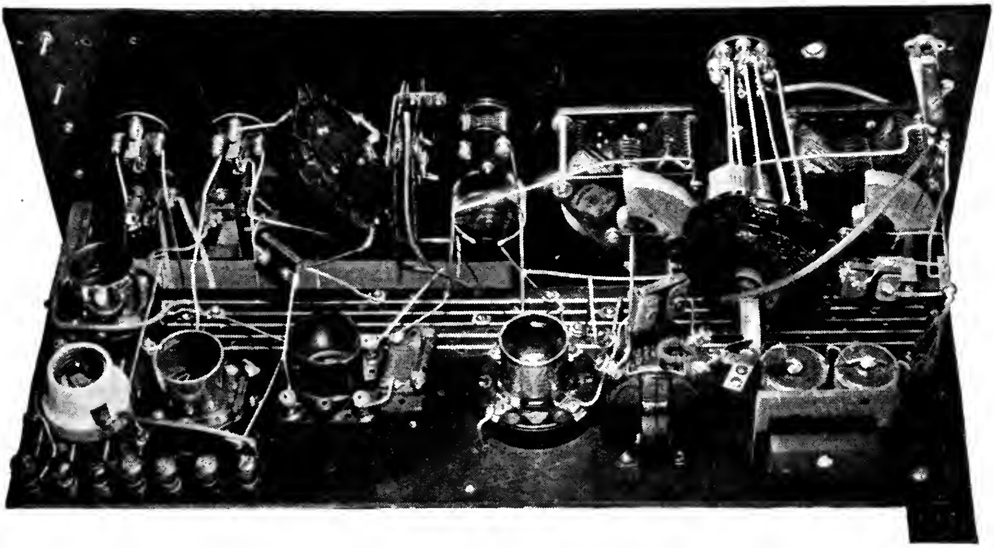
A new form of base came out at this time in which the circuit leads were imbedded in the panel, in grooves. At convenient intervals are holes, to which connections are made with a machine screw and washer. This makes an orderly manner of distributing wires, allowing short leads, so desirable in cutting down resistance. Well tightened, these connections make sure contact, something not always true in a soldered joint. The push-pull transformers were mounted underneath the base, thus making more breathing space up aloft. Some of our radio troubles are caused by crowding. Too many dogs in one manger—and nobody gets any rest. You know it.

I found in a small variable neutralizing condenser just the little touch that makes a radio fan glad he is alive. With this condenser, distant stations can be lifted up to the point of loudest audibility. As a matter of fact, one can go pretty far toward controling regeneration with it. It is far more shipshape than the "Granddaddy Longlegs" arrangement of spaghetti and bus bar, and I am most emphatically for it.

The mounting that comes with the ready-

Where the Cynics Gather

Is usually in a newspaper office, and since a lot of the fourth estate have become radio enthusiasts, much of their cynicism has been directed toward radio and some of its works. From the time that the Roberts Knockout receiver was first described in this magazine for April, 1924, we have received great numbers of letters telling of the experiences of many builders of this set—some serious, some humorous, but all decidedly interesting. As Mr. Bradford confesses in his article, he has lately managed to take some of his spare time and devote it to the compelling art of radio. His experiences with the Roberts Knockout receiver are so typical of others and his relating of them so interesting that probably more than one constructor whose hands often curl lovingly around pliers and soldering iron will chuckle an appreciative chuckle when he reads this.—THE EDITOR.



THE RECEIVER

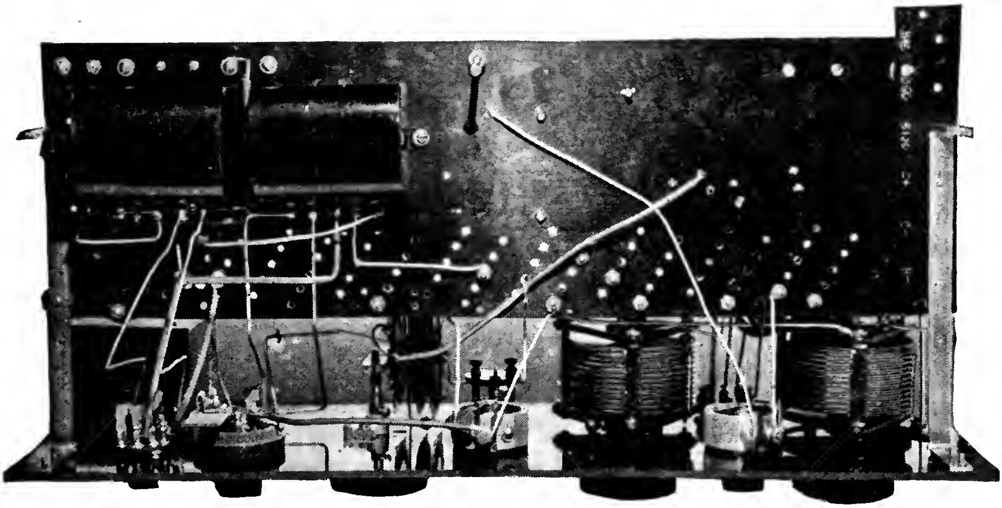
Constructed by Mr. Bradford who has incorporated some interesting changes in the four-tube circuit originally described in RADIO BROADCAST for September, 1924

made coils is a bit amateurish, so I constructed a more manageable mounting, wherein space was saved, and better control effected. These are little details one will work out for oneself. The answer in radio seems to be—the desire for a certain thing is generally the father of the deed that gets it.

You will notice generous width of panel, nine and a half inches. This made the easiest hooked up set I ever worked on. As a matter of fact, I think I whistled "Buffalo Gals" most of the time when assembling it. Thus, I am sure of a rebate from The Gods What Am, having made a record for profanity on all the other sets I ever constructed. (How many? —I'm ashamed to tell you!)

THE ROBERTS ON A LOOP

MY FIVE-tube r. f. set worked fine on a loop. I had an idea the Roberts would have something to say along this line, so I arranged a double jack that cut out the antenna



UNDERNEATH THE PANEL

Of Mr. Bradford's Roberts receiver. Push-pull transformers have been mounted underneath to save space on top

coils when the loop was plugged in. Our building is a twenty-one story affair, of steel girders, yet the Roberts has pulled in on the loop, WGY, WEAF, and KDKA. WGY and WEAF, could only be heard when the locals were not on, for our two local stations are not more than five blocks away from my window!

"Now" said everybody: "You have SOMETHING! For heaven's sake, leave it alone!"

Did I leave it alone? It was but natural that I should try to paint the lily. Ha! I would put one over, even on old man Roberts himself! Another stage of audio was added before the push-pull. Did you ever see a pup that bit into a hornets' nest? I was him. The result was a devils' chorus that would have warmed the heart of old Pluto himself. Squeals. Howls. Demoniacal chuckles. All the red-faced hyenas of the infernal regions were using my Roberts for a speaking tube. (Fortunately, this attempt was made at my own home, otherwise, my stock in trade as a "radio expert" would have suffered in the estimation of my office mates.)

Still, in the opinion of cartoonists I am a "radio expert." In the opinion of radio experts I am—well, some kind of a cartoonist, probably. There you are.

I have tried the Roberts on all the tubes a fan would use. Works fine on all, with the biggest rumpus, on the 6-volters, of course. Clarity of tone is one of its biggest selling points.

Using a loop, at my home, in West Philadelphia, WDAF, Kansas City, and WCAL, Northfield, Minnesota, have arrived on the Roberts, using phones. Nice, hm?

A RARE PHOTOGRAPH
Of a demon discovered and photographed by Mr. Bradford. This imp is seen in a particularly quiet pose, observing the personified device used by the author of this article guaranteed to destroy this menace

THE HORRIBLE MIXTURE
Of cartoonist and one too many audio

So far, it has not been tried on an outside antenna. When I get around to it, I shall chloroform the landlord and erect an outside antenna, whereupon, I expect to tune-in London, and get an earful of "How to Make Chow Chow by Radio" from Cross and Blackwell, in Soho Square.

In the accompanying photograph of my receiver, you will notice an ordinary electric light socket at the left on the base panel. When a 25-watt bulb is inserted in this socket, which is wired in series with the B minus lead, "Inkus Buhjinkus," the Eskimo imp, can jes' hang around all he wants to. Tubes simply can't blow with this life saver in. This has saved the humble writer much spondulix, for tubular kohinors are worth in the neighborhood of $4 per groan. (Note the photograph of Mr. 25 watt-er giving Inkus Buhjinkus the merry ha-ha.)

WHAT HAPPENENED IN PHILADELPHIA

I PUBLISHED a short account of my experience with the Roberts in the Philadelphia *North American*, the paper I am tolerated on. I had to bribe one of the office stenographers to help answer the raft of correspondence that followed. To my knowledge, there has never

been a set that has caught on like the Roberts has done. Given good material, and care used in assembling and wiring, "success waits on radio appetite," so to speak.

One of my neighbors, aged 71, built a Roberts, and swears he is 10 years younger, through pure joy. (And I know a lady fan, who "rolls her own" who swears she will kiss Walter Van B. Roberts on sight—and were I Roberts, I shouldn't disguise myself on that threat).

And me? Oh, I have no time for anything but my Roberts. The battery charger is buzzing all the time, and the stockholders of the electric company have all bought fur overcoats.

Oh, faithful and willing set, you have warmed the cockles of my heart.

But—alas. There is always a ghost at the banquet. The cat and the canary mope in jealousy, and Betterhalf has gone in for the movies. It's a habit now.

Where is mother? At the movies.
Where is Dadah? At his set.
He is tuning-in for England
Which he hasn't gotten—yet;
Mother's lonesome—mother's frantic
And she threatens—a divorce!
But that's futile, for like nature—
Radio will run its course.

An obliging enthusiast bought my five-tube r. f. set. Good bye, ol' top, you were a good old wagon, but the Roberts—the Roberts is a Rolls Royce. *Pax vobiscum!*

Well, that's the end of that; Now for the fireworks.

Roberts, Roberts, you're a blessing,
For your set, in any dressing
Makes of radio, a heaven,
With your neutralizing "leaven."
Gone—is rumpus in the feedback—
(Due to demon's teeth, on hardtack?)

Amen. Do it with a Roberts.

IN THE CARTOONIST'S LAB

The assembly is listening to the Roberts Knockout "telling 'em"

At Last—Great Artists Over the Radio

THE expected happened when the phonograph companies began to feature their artists over the radio. Many who are equally familiar with the music and the radio game knew that in time the phonograph manufacturers would relax from their autocratic attitude in forbidding any of their artists to broadcast and would realize that in refusing to use the microphone as a means of advertising they were neglecting a rich opportunity.

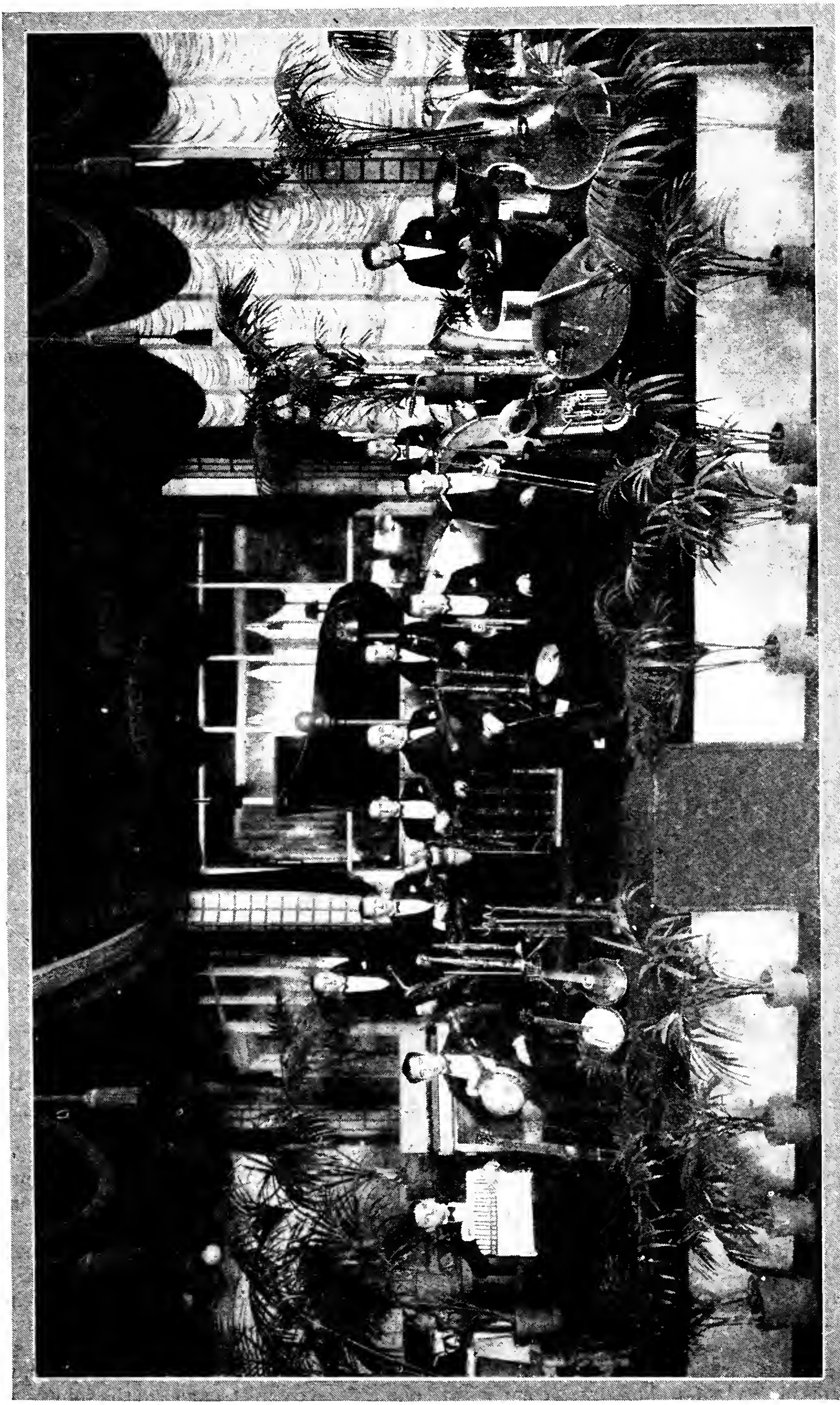
Still, the change came rather suddenly. To the Brunswick-Balke-Collender Company goes the credit of taking the initiative in what is the most significant development in radio programs since broadcasting was started.

To be sure, the Brunswick firm had somewhat prepared the way by making records of the chief hits of some of the popular radio singers and players, and advertising them as radio favorites, thereby selling many of the records. But that was quite different when that company suddenly sprung on the public the news that Florence Easton, one of the leading sopranos at the Metropolitan, Mario Chamlee, who holds a position as tenor of equal prominence at the same house, Elly Ney, pianist, and the Cleveland orchestra, would be heard in the first of three programs to be given by Brunswick recording artists during December.

Then came the Victor Talking Machine Company with the announcement that on New Year's night they would present Miss Lucrezia Bori and John McCormack in the first of a series of radio programs to be given by their artists. One would have thought, in reading many of the papers after this performance that never before in the history of radio had the great stars in the musical world broadcast. This was a deep injustice to the Brunswick Company and the artists they had up to that time presented before the microphone. The first program of the Brunswick artists in all respects equalled and in some ways excelled the first Victor program. But then, no intelligent person was beguiled by the newspaper reports into the belief that the Victor program was the first one of its kind broadcast. We have no issue to raise with the Victor people regarding this matter. Our complaint is against the press, which did not state the case completely. We believe in fair play.

There has been no end of discussion in the papers regarding whether these artists who have so far been heard on the Brunswick and Victor programs, are or are not paid. The Victor Company has announced that all of their artists are giving their services for these initial experiments. But this is a matter with which the public has no concern. It is a business question to be decided between the recording companies and their artists. For this entire scheme of the Brunswick and Victor companies in putting their singers and instrumentalists on the radio is a business proposition, and it is quite right that it should be. They are out to sell records, and let us hope that they will sell so many more of them than ever before that they will feel they can never desert the microphone as a means of advertising. If, on the other hand, they do not find that the returns justify the expense involved, a large public will have had the opportunity to hear artists they could never have heard in any other way.

True, with radio in its present uncertain



Bloom, Chicago

THE ORIOLE ORCHESTRA OF CHICAGO FREQUENTLY HEARD THROUGH STATION WEBH

state so far as good production is concerned, some may have failed in trying to hear the artists so far featured on these programs. But to one such person there are no doubt hundreds to whom the voice, the instrument, the interpretation, came through with a clearness that brought keen satisfaction.

But let us not lose our heads. It was amusing to read in the New York *Times* the day after this Victor program was broadcast, a wail from William A. Brady over the vacant seats in the theaters New Year's night. According to him, every one had stayed at home to hear this concert. The theater faced ruin. Even when great stars were not broadcasting, the theater crowd stayed at home to listen to the music broadcast!

If Mr. Brady thinks that any one who knows a good play when he sees it is going to stay away from the theater when a good play is on because he prefers to hear radio music, then Mr. Brady's knowledge of radio music is exactly equal to a cipher.

No, let us not lose our heads. These programs put on by the phonograph companies are going to help radio music tremendously. But they are not going to dominate. Just as every city in the country of any musical ambition has a few concerts of superlative importance each season, with the remainder of the musical attractions of far more than average merit, so it will be with radio, even if all the phonograph companies go into the business of broadcasting. We need these great artists to sing and play for us, and equally, if not more, we need the near great, those who are also artists, but not of world fame. It is such as these who are going to raise radio music to a standard where it can command the respect of those with artistic ideals.

It must be borne in mind that not all the programs put on by the phonograph companies will be given by famous concert and opera stars. Artists who make "popular" records will be heard as well—but then, when you are out to advertise your wares, if you are wise, you are going to advertise all of them and not just the *de luxe* variety.

Underwood & Underwood, New York

MARCEL DUPRÉ

The great French organist who has been broadcasting from WJY and several connecting stations. He is here seen at the Wanamaker concert organ in New York where he played all his programs

When Talented Music Students Broadcast

ONE feature that is becoming conspicuous on the programs of some of the best conducted broadcasting stations, is the presentation, by a music teacher in the city where the station is located, of a program given by members of his or her master class. Some excellent programs of this nature have been heard from WCX, Detroit, since that station moved to the Book-Cadillac Hotel while still keeping relationship with the Detroit *Free Press*. If a teacher's master pupils do him credit when heard over the radio he thereby has had at his disposal an advertising means more far-reaching than he could attain in volumes of the written word. We are glad to record that WCX is not alone in having successfully featured such programs.

A Protest Against Bad Taste and Bad Judgment

MANY requests have been received by the conductor of this department to enter a protest in these columns against the campaign conducted by station WOS, Jefferson City, Missouri, to raise money for Harry Snodgrass, "King of the Ivories," so that he might have a fund with which to start life anew after leaving the Missouri State Penitentiary.

Among these letters, all from strangers, was one that so completely covers the subject that

Apeda, New York

MME. ELLY NEY AND FLORENCE EASTON

Mme. Ney, pianist, who in private life is the wife of Willem Van Hoogstraten, conductor of the New York Philharmonic Orchestra, was one of the star attractions of the radio program broadcast by the Brunswick Phonograph Company recently. Mme. Easton is a leading soprano at the Metropolitan Opera House and also appeared on the Brunswick program which was the first ambitious large scale broadcasting ever to be arranged by a phonograph company

it is here quoted in full as the best means to show the consensus of opinion of a large public. If WOS knew just how large that public is, those in charge of that station might do some worrying.

The letter, which is from A. O. Weiss, of Copperhill, Tennessee, reads:

I have followed with interest your articles in Radio Broadcast. You represent, probably, the first effort in radio to keep it clean and on a high plane. God knows, your work is necessary and should be amplified.

I—or rather, we were listening to a program from WOS, Jefferson City, to-night. It was a solo program, by Harry M. Snodgrass, a convict in the Missouri State Prison. It would seem that they are running a benefit for him, and his musical numbers were interspersed with announcements of letters and telegrams contributing money for his benefit. He is to be released shortly.

He collected, by this means, several hundred dollars. I have no fault to find with this. He is an entertaining chap on the piano, the Coney Island kind of an entertainer. There are plenty of him over the country. I will confess that I sometimes enjoy him myself. However, what I do find fault with is the exalting of a criminal over the radio, and the detrimental effect it must have on children. I have seven. They know that this man is a criminal, and they hear him called "The King," and hear of the money being sent in to him. This is absolutely *bad!* I know nothing of his crime. I am no Puritan. I would gladly help him to regain his mental health. But I seriously object to such propaganda as WOS has put forth in his behalf being broadcast into the homes of decent Americans. We need our moral foundations a sight more than we need Harry M. Snodgrass's music.

Such a letter needs no comment. It will inspire the respect and admiration of all those who give the matter intelligent thought.

How Much Jazz Is Enough?

BUT if this degradation of broadcasting brought protests to the present writer, they were exceeded in number and virulence by those that came soon after Christmas denouncing the jazzing by an orchestra at station WTAM, of "Silent Night, Holy Night." Some beneficent fairy kept us from tuning-in on that sacrilege, and for a time we hotly denied that such a thing could have occurred. But the evidence that poured in was irrefutable.

Jazzing "Silent Night, Holy Night"—to what base depths the mind of man can sink!

From all over the country come endorsements of the policy of this department in

fighting for good radio music. Note, these excerpts from a letter received from Captain W. C. Mahoney, Fort Benning, Georgia.

I believe I can speak for the average broadcast listener, for I am neither a highly educated musician, nor am I entirely ignorant of the effects of good music. Neither have I an objection to a reasonable amount of modern music in its place. I do however believe that if the broadcasting stations at large would adopt a plan of putting on programs that contained more high class music and eliminate so much jazz, that they and the entire public would benefit thereby.

There follows a warning that every radio manufacturer and dealer should take to heart:

The public is not only getting tired of so much jazz, but is getting disgusted, and the radio business at large is certainly going to see a marked reaction unless the broadcasters wake up to the fact that the general public is demanding programs of higher grade music.

Captain Mahoney then goes on to call attention to the fact that the Crosley Station at Cincinnati is making a feature of what, for a better term, we must call classical music. He also speaks of Zion City, that never puts on any jazz at all, every program being harmonious—whether classical, semi-classical, or religious. With this we heartily agree. This station is always above the average in everything it does. Many of the religious programs are beautifully chosen and presented, while the secular programs might be taken as models by a dozen stations not far distant from Zion City.

Then, from Edgar Felix, who has been as close to broadcasting behind the scenes, as any man in this country, comes congratulations on our attitude toward radio programs. He was until lately publicity director for station WEAF, the American Telegraph and Telephone Company, and is now with N. W. Ayer and Son. He writes:

During the last few weeks, in the course of some experimental work in receiving set design, I have had occasion to listen to the programs of scores of broadcasting stations all over the country. It is obvious that the average manager conceives the radio audience to be a most preposterous group of frivolous jazz enthusiasts. As station after station is tuned-in, we are treated to the painful strains of the weeping saxophone, or the tearful ballad entertainer. The preponderence of this type of program is well nigh overwhelming.

On the other hand, when I was with WEAF, I remember that we felt the mail response to the programs of the Philharmonic Orchestra broadcast was a decisive indication that there is a large element preferring classical music. And the response to the ballad programs . . . given during the Eveready Hour, brought numberless letters showing that the people prefer good ballads to the sentimental trash so often broadcast under the name of ballads.

Bain, New York

LUCREZIA BORI AND JOHN MCCORMACK

Recording artists of the Victor Talking Machine Company, who broadcast through a chain of eight stations on New Year's night. Miss Bori is a member of the Metropolitan Opera Company and Mr. McCormack is the famous concert singer. The phonograph company announced that its entry into the broadcasting field was purely an experiment and if successful would be continued for its advertising value

You are no doubt by this time familiar with the new announcement form used by WBZ: "This is WBZ, New England." Regarding which the Springfield *Republican*, in an editorial, has this to say:

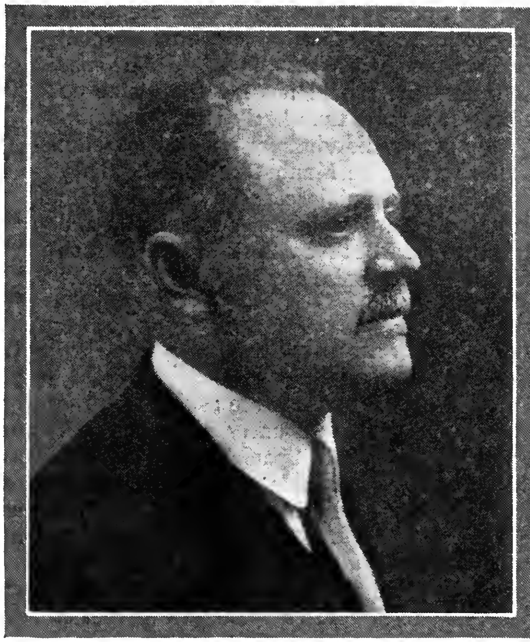
"The Springfield devotees of the radio are bound to consider it rather small business for the management of WBZ deliberately to omit from its announcements the fact that the broadcasting is actually done from this city. To say, 'This is WBZ of New England,' is not fair to

proud Springfield, and it is not giving the listener-in elsewhere a bit of the essential information that seems to be given in the case of about every other broadcasting station in the country."

After agreeing that the Westinghouse Company may, from its point of view, have good reasons for thus slighting Springfield, the editorial concludes with the pointed comment:

"The broadcaster does not have to name the city in every other breath, as he has been accustomed to name the Westinghouse Company, but, in all fairness, it ought to be plainly stated, as is done in the case of other stations, that the broadcasting is done from Springfield."

To which we wish to add that, as it comes over the radio, "WBZ of New England," sounds plainly silly. One would think that WBZ was trying to claim that it had a broadcasting station in every city, town, village, and hamlet in New England, or else was the only station in Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut. (Are the states all there? It's a long, long trail back to school days.)



CLARENCE W. ALLEN

Director of the Church Community Chorus which broadcasts every Sunday from WJZ. Mr. Allen often gets his listeners-in to sing with him, but how he does it is a mystery to many of us

In the radio column on the editorial page of this same edition of the *Republican*, the writer forecasts one of the phases of a radio Utopia when he says that at the time any really notable musical performance is being given over the radio all interfering stations should remain quiet. Whether a play, an opera, a symphony, or a string quartet is being given, it ought to be possible to hear it as a whole and with the minimum of mechanical interference and extraneous noise. "Such an experience," concludes the article, "once a month would be of more solid value than a surfeit of scraps from many tables."

Wait, five or six or seven years, and not only may such good things as this come to pass in broadcasting, but even greater things.

G. B. S. at the Microphone

ONE man reading a play to a radio audience is not a success even when that man is Bernard Shaw and the play is his own, according to the reports published in the London papers after Shaw had read his *Flaherty, V. C.*, from the London station of the British Broadcasting Company. Yet all acknowledged that he carried off his task with superb ability. The trouble was that the audience could not visualize all the people he tried to impersonate simply by a change of voice. Radio has its limits and it is not going to eat up the theaters and the concert halls and the opera houses as some alarmists would have us think.

Lopez at the Metropolitan

MR. Hurok, concert manager, and manager of the Lopez Orchestra, uttered a loud complaint against radio after a concert recently given at the Metropolitan Opera House by Vincent Lopez and his orchestra of forty pieces. The attendance was small. Mr. Hurok blamed it on the fact that the Lopez Pennsylvania Hotel supper-dance programs are broadcast.

It seems not to have occurred to Mr. Hurok, first that very few people would go to the Metropolitan Opera House, a place of vast expanse, to hear any orchestra of forty pieces. And second, that the public upon which he would draw for this concert could hear Lopez in his natural environment at the Pennsylvania any night. Perhaps they would go to the Metropolitan to hear Paul Whiteman—once. But from this Mr. Hurok should not

rush to the conclusion that they are going there to hear any other jazz orchestra of small numbers, and when they failed to patronize his concert he should not lay the blame on radio. It is more than likely that the majority of Lopez's radio admirers, and he has many, live far away from Manhattan Island. They would go to a public concert given by him because they would be eager to see him and his orchestra. But New Yorkers have no such incentive to patronize any paid public concert he may give.

They Talk Fast in Cuba

THE Cuban stations are asking that the stations in this country give their call letters in both Spanish and English. That would be a simple matter, and there seems no reason why the request should not be granted. But among the reasons that prompt this request, explain the Cuban stations, is that the American announcers talk so fast no one, not even a Spaniard who speaks English——can understand anything that is said.

But have you ever tuned-in on a Cuban station when some Spaniard was making a speech? His speed would put the most fluent announcer in this country to shame, even if the American announcer were trying to make a record for speed.

French Efforts to Pay for Broadcasting

THE United States is not the only country that is struggling with the question, "Who is to Pay for Broadcasting?" The *Compagnie Française de Radiophonie* of Paris recently sent out an appeal for financial support to those who previously had expressed interest in their programs. Prefacing a coupon which the contributor could fill out with his name and address and the amount to be contributed for the year 1924, was the following statement:

> In England, the Broadcasting Company is remunerated indirectly by the listeners by means of rents, or dues, payable to the General Post Office.
>
> In France the administration of P. T. T. asks for itself only one franc from the listeners for dues, so that the *Compagnie Française de Radiophonie,* which neither constructs nor sells any apparatus, must assume considerable expense in order to maintain five hours of broadcasting daily, to which tens of thousands in France and foreign countries listen. What you wrote us some time ago, and for which we thank you, makes us know that you appreciate our programs. If you wish to have a share in our expenses, and also coöperate in the improvements we have in view, we shall be greatly obliged to you.

Such a plan could be made to work more readily in France than in this country because over there the number of broadcasting stations is small as compared with the number on this side of the water. How this plan is progressing we have not yet heard. It is not new. It has more than once been brought up as a possible solution to the financial problems of broadcasters in this country, and has wisely been abandoned as impracticable, for the reason that the contributions would be but a temporary means of support with complete uncertainty as to what might be forthcoming in the future.

Credit and Appreciation for Radio Accompanists

ACCOMPANISTS for radio singers and instrumentalists get almost no credit for their work. The truth is that quite often the accompanist is better than the one he accompanies. It is a thankless job, even on the concert stage. It must be a discouraging job behind the scenes of radio, except in those cases where the accompanist is the official pianist of the studio, when this task comes as simply part of the day's work.

FROM Dorothy Doane Haynes, of Winfield, Kansas, comes a cheerful letter stating that, in her opinion, broadcasting is taking on a much more satisfactory aspect. One of the cases in point she cites to prove this is: "Why! KFKX doesn't even say 'radiocasting' any more!"

IT IS so long now since Christmas that probably few people can remember what gifts they received. But every one who listened-in to the Christmas carols must have rejoiced to have a radio set in his home. The highest praise is due all the leading broadcasting stations in the country for the carols and other forms of Christmas music they gave the public an opportunity to hear.

How to Wire Your Home for Radio

A Central Location for the Receiving Set and Proper Connecting Mains to the Various Rooms Is the Plan

By JAMES MILLEN

THE ideal location for the radio set in the modern home is difficult to find. Of course, there are "tea-wagon loop sets" which may be wheeled from room to room with only slight inconvenience, Some multi-tube ones are fairly portable, since a handle is attached to the cabinet. It is often inconvenient in the average home to attempt to take such an outfit to an upper floor at different times throughout the day as might be most desirable should some unfortunate member of the family be confined to the sickroom.

We don't generally put a handle or wheels on the furnace, coal bin, and ash cans and then take them from room to room in order to have heat where we most want it at any particular time. Why not, then, permanently locate the radio set in some convenient spot (not necessarily the cellar, of course) and "pipe" the output to the several places where its presence may at times be most desirable, such as the living room, front porch, dining room, den, or kitchen. As the cost of a half dozen or even fewer high grade loud speakers is in most cases prohibitive, neat and inconspicuous outlet boxes may be provided in their stead. Then it will merely be necessary to move one loud speaker about the house, plugging it in in much the same manner as an electric heater or other such appliance.

The location of the set itself could then be in some secluded spot, which good engineering practice would proclaim as best suited for long distance reception or, if the owner prefer, the set might well be kept in his workshop where one set of batteries could supply any receiver or receivers he might have there.

How can it be done? Will the reception be just as loud and clear with the loud speaker so far removed from the set? How can the volume be changed without going to another room and re-adjusting the set? In the next few paragraphs an attempt will be made to answer these questions as well as some of the others which may have already come to the reader's mind.

HOW TO MAKE THE INSTALLATION.

THERE are, no doubt, a few ambitious persons who will prefer to "snake" the wires between the walls and above the ceilings, but most of us will be satisfied to run the wires along the cellar ceiling and up through small auger holes to the desired outlets. The wire may also be concealed behind the picture moldings or neatly tacked along the top of the base boards. Many good ideas about making this wiring may be obtained by examining your telephone installation. The main thing is not to run parallel too closely to exposed electric light wires or *un-grounded* BX cables, in which electric light wires are run. The best wire to use is a double No. 18 bell wire.

The Radio Mohammed

Is brought easily to the radio mountain if he wire his house according to the suggestions of Mr. Millen in the accompanying article. Very frequently it is inconvenient for a radio receiver to be taken from room to room in one's home and from one floor to another. If outlet wires be strung as this article outlines, only the loud speaker need be transported. Of course, the receiver has to be tuned and the variable voltage adjustments made before the outlets are used, but that, in general, is no especial hardship. If the experimenter is especially interested, it will not put him to much trouble to arrange a system so that when the loud speaker plug is removed from the outlet base the filament circuit of the receiver is opened. Some experimenters may even wish to arrange a distant control system so that the set may be tuned from a distant point.—THE EDITOR.

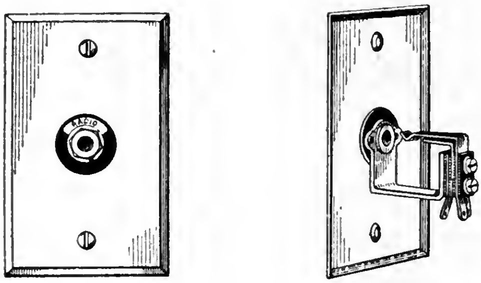


FIG. 1

One type of baseboard outlet box which can be used for connecting the loud speaker to the radio set which is located in a central spot in the home. Front and back views are shown in the sketch

This wire comes with a fairly heavy insulation. It is not twisted and is contained in one cover so it is very easily pulled through small holes without excessive jamming.

PLACING THE OUTLETS

THE outlets may be rigged up in any number of ways, depending upon the individual tastes of the builder. Where a box is to be "sunk" into a wall, then a standard brass

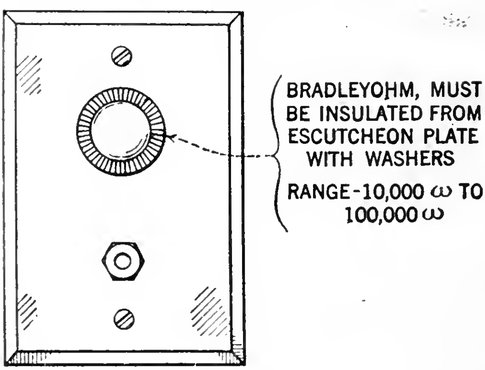


FIG. 2

An outlet which can be built up, containing a variable resistance to regulate the volume delivered to the loud speaker. Where a resistance is mounted in each outlet box, it is unnecessary to regulate the receiving set directly, once it is tuned to a given station

escutcheon plate with a jack as obtainable on the radio market (Fig. 1) may be employed. Otherwise a plain brush-brass escutcheon plate such as used with the ordinary two-button push switches may be fitted up with a jack and variable resistance for controlling the volume. (Fig. 2). The resistance is shunted across the line and should preferably be connected so as only to be active when the loudspeaker plug is in the jack. In order to accomplish this it will be necessary to re-arrange the contacts on the standard jack, or to use a series instead of parallel circuit. (Fig. 3). If no provision is made for automatically tak-

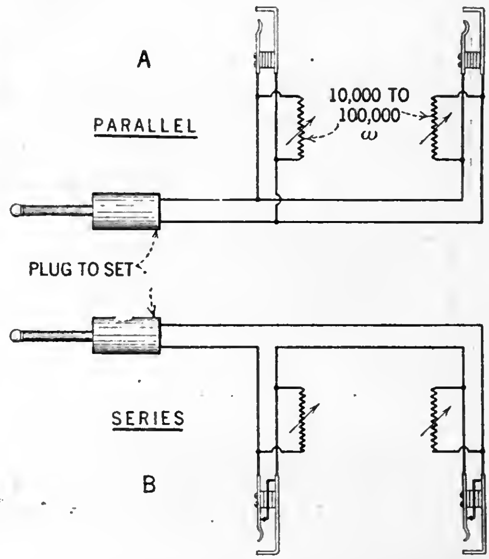


FIG. 3

Two ways of connecting the outlet feed wires to the radio set. A controlling resistance is necessary to regulate volume. The series connection in "B" is recommended because the extra blade on the jack automatically short-circuits the variable resistance in the circuit when the plug is out of the jack

ing care of the resistance connection, it may be necessary now and then to examine the connections in the radio-house-wiring to find what resistance is connected and which is causing the lack of volume. It is, however, always easily found.

A much more easily installed outlet consists of a small box with a flexible cord connection. This may be placed on a table, window sill, or even the floor. Should no volume control device be desired, then an enclosed jack of the type shown in Fig. 5 may be used.

TROUBLE ELIMINATION

SHOULD trouble due to whistling occur when the loud speaker extension line is being used, it may be rectified either by shifting the lines or using a low impedance speaker and installing the transformer at the receiving set end of the line.

REMOTE CONTROL

A CONSIDERABLE field for some interesting experimental work is available to the fan who cares to arrange a remote control so

that the set may be turned on or off, or, for that matter, tuned-in on any of the stations which come in with loud speaker volume. As remote control will interest but few, no effort has been made here to discuss that problem. In general, the difficulties of such an arrangement, when used by the average broadcast listener, far outweigh its advantages.

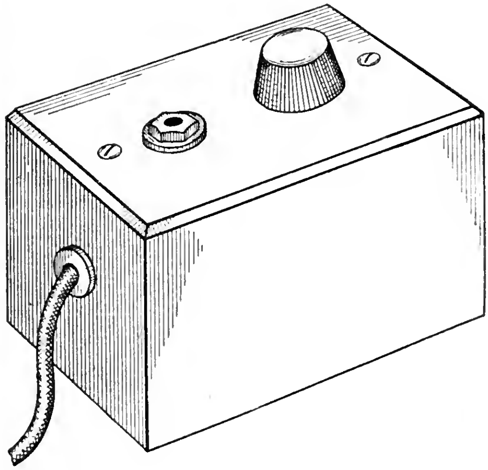


FIG. 4
A compact outlet box containing the variable resistance and jack, with a long flexible lead going to the output of the receiver. This arrangement can be used where the experimenter does not desire to install the baseboard feed circuit

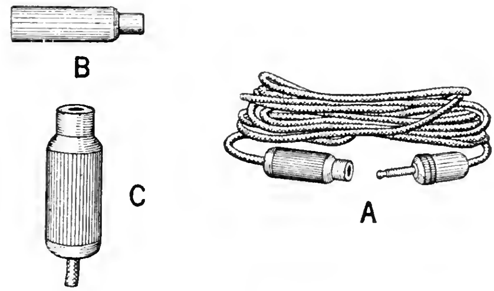
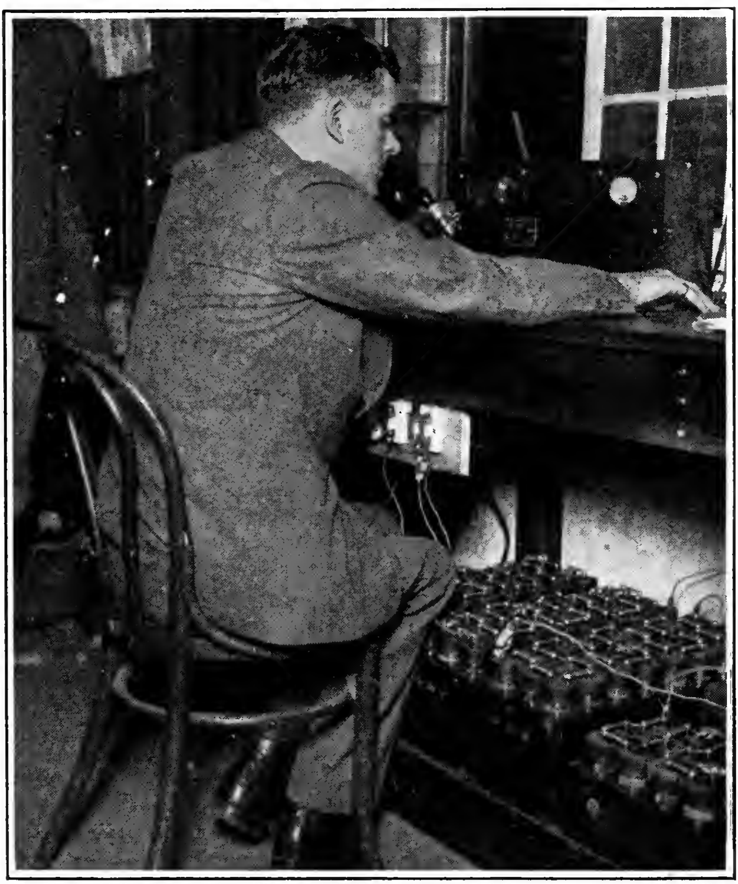


FIG. 5
A long cord with plugs, such as these sketched can be used by listeners who do not care to use any of the other methods suggested in the article



IN THE RADIO BROADCAST LAB
The Radio Corporation twenty-watt tube transmitter whose plate supply is furnished by a three hundred and fifty volt bank of Presto-lite storage B batteries

MR. WINSTON CHURCHILL

Making a political address in England in which a public address system and radio broadcasting are being used to spread his voice over great distances. Political addresses are much the same the world over, and the microphone and loud speaker are now accepted as a necessary adjunct. Mr. Churchill is Chancellor of the Exchequer in the present English cabinet

THE MARCH OF RADIO

By J. H. Morecroft

Past President, Institute of Radio Engineers

Hoover's Suggestions for New Radio Regulations

APPARENTLY feeling that the power at present vested in him is not as well defined or as inclusive as he would like to have it, Herbert Hoover, Secretary of Commerce, has suggested to Representative White that he prepare a short bill (the wording of which Mr. Hoover gives) instead of attempting any broad regulation of radio at this time. The bill Mr. Hoover suggests asserts that the people of the United States are entitled to the inalienable possession of the ether within the confines of their coun-

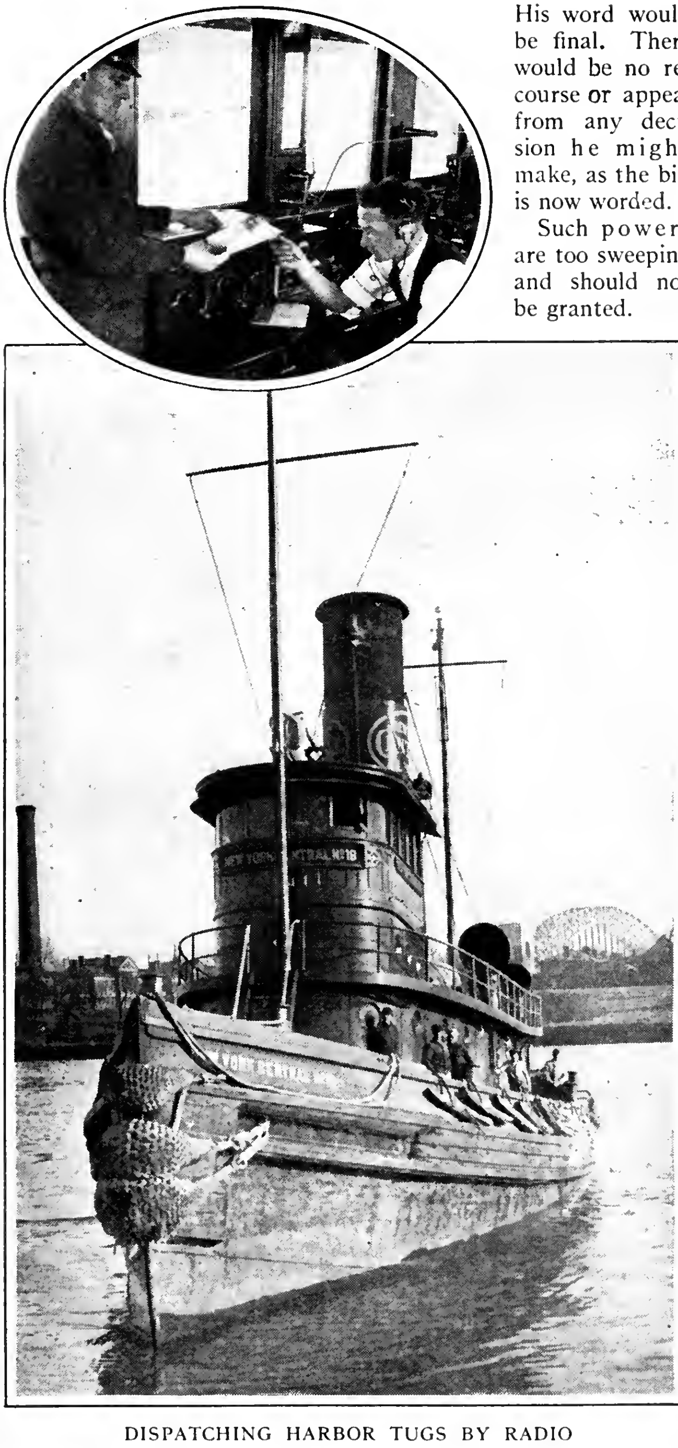
try, and then amends the Radio Act of 1912 to read:

The wavelength of every radio transmitting station for which a license is now required by law, its power, emitted wave, the character of its apparatus, and the time of transmission, shall be fixed by the Secretary of Commerce as in his judgment and discretion he shall deem expedient, and may be changed or modified from time to time in his discretion.

Such wording certainly relegates plenty of power to the Secretary of Commerce—far too much, in the opinion E. F. McDonald, Jr., President of the National Association of Broadcasters. Says Mr. McDonald: "I have unbounded confidence in him (Mr. Hoover) and would be in favor of putting this tremendous power into the hands of the Secretary of Commerce on one condition, and that is, that Mr. Hoover give to the radio broadcasting industry a guarantee that he will live for 100 years and that he will serve as Secretary of Commerce for that hundred years. In other words, Mr. Hoover, we don't know who your successor is going to be!"

Mr. McDonald's point is well taken. The actions and policies of Mr. Hoover during the last few years have given the radio broadcasters every confidence in his judgment, and all of them would cheerfully abide by his decision in any matter he deemed it wise to regulate, but to confer on any Secretary of Commerce such Napoleonic power as this brief paragraph would do, seems certainly unwise. His word would be final. There would be no recourse or appeal from any decision he might make, as the bill is now worded.

Such powers are too sweeping and should not be granted.



DISPATCHING HARBOR TUGS BY RADIO

Is being tried by the New York Central Railroad in New York harbor. The Company anticipates saving much time by being in constant touch with the captain of each tug. The inset shows the radio cabin and tube transmitter which operates on 660 meters. Because of the small space available, the radio apparatus is installed in the pilot house

THE FIRST TELEPHONE RECEIVER WITH A PERMANENT MAGNET

The case is of wood. The diaphragm is made of an old tin-type with an iron magnetic core around which the wire coil was wound. This receiver was made by Professor A. E. Dolbear while he was a student in Ohio Wesleyan University at Delaware, Ohio. It was recently brought to light again in the University's physics laboratory

Mr. Hoover's letter covering the transmittal of his suggested bill to Mr. White shows how well he has grasped the essentials of the radio industry as it exists to-day. After reviewing the advances and changes during the past year, all of which indicate the inadvisability of governmental regulation at this time, he says: "I hope that another year's experience will show what direction of legislative course must be pursued. Meanwhile I feel that we would gain by allowing the industry to progress naturally and unhampered except by the maintenance of a firm principle of governmental control of the ether and the elimination of interference so far as possible."

An Epoch in Broadcasting

SETTING a rapid pace for 1925 broadcasting to follow, WEAF announced that through coöperation of the American Telephone and Telegraph Company, The Victor Talking Machine Company, and the various artists involved, January 1st and succeeding nights saw the inauguration of a great broadcast experiment. On that evening John McCormack and Lucrezia Bori, two of America's best-known operatic stars, gave a program of arias and favorite old songs which all radio listeners hailed with delight. These were exactly the type of programs which we have always visualized for broadcasting. To be sure, lots of folks can enjoy jazz and second-rate humor, but many of us prefer other than vaudeville programs. To suit a million people who are listening, a program of variegated character is required, but in this program lovers of real music had their turn. It was suggested that if this experiment was successful, more programs of like quality would follow.

The artists who have agreed to assist in this new phase of broadcasting, all of them Victor artists, are Alda, Bauer, Bori, DeGogorza, DeLuca, Fleta, the Flonzaley Quartet, Gordon, Jeritza, McCormack, Martinelli, Matzenauer, Ponselle, Schumann-Heinck, Scotti, Whitehill, Paul Whiteman, Crooks, and the Shannon Quartet. There are still a number of well-known Victor artists who have not yet agreed to broadcast, but it is quite likely that if the quality of WEAF's transmission keeps up to its present high standard and the public show a real appreciation of the programs rendered by the artists who have already agreed to broadcast, the others may join in to give us, the "dead-beat" audience, broadcast entertainment to which we are not at all entitled by any right of payment, but which we shall welcome nevertheless.

Radio Dispatch for Harbor Tugs

WHERE other means of communication fail, let radio be used—seems to be a logical dictum by which to allot different communication tasks to the different possible mediums. Certainly contact with moving vessels can most conveniently be had by radio and we believe that the attempt of the New York Central Railroad Company to handle its harbor traffic by radio is justifiable. The company operates forty-three tug boats in New York harbor and undoubtedly this harbor traffic could be speeded up if the chief tug dispatcher could talk to his captains whenever he wanted to. Although the experiment is being started on a 660 meter wave, it seems as though a much shorter wave would have been preferable, much below the normal broadcast range. As the distances to be covered are small, probably a 5-watt set operating at, perhaps, 20 meters might do the work very well, certainly much better than the channel at present being used.

How to Calibrate Your Receiver

THE latest list of "standard frequency" broadcasting stations put out by the Bureau of Standards is well selected to help the radio enthusiast who wants to construct an accurate calibration curve for his receiving set. Of the following stations, whose frequencies reach right through the broad-

cast range, none has an average deviation from its specified frequency by more than two tenths per cent. This means an accuracy much better than that to which the dial of the ordinary receiver can be set. Here are the stations:

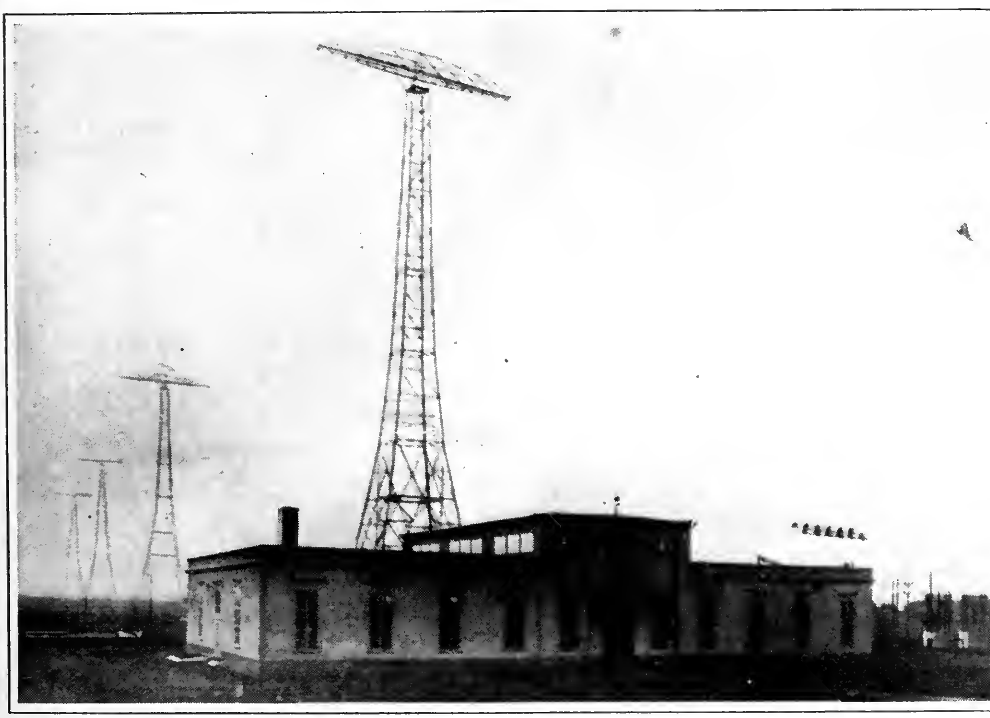
WWJ	Detroit	580	kilocycles
WCAP	Washington	640	"
WSB	Atlanta	700	"
WGY	Schenectady	790	"
WBZ	Springfield	890	"
KDKA	Pittsburgh	920	"

Of course for any one within hearing distance of the Bureau of Standards Station, WWV in Washington, or station 6XBM at Stanford University, their standard wavelength signals periodically sent out on a definite schedule, are even more useful for calibrating purposes.

A New Toll Broadcaster

TO ANY ONE having an interest in economics it is a puzzle to discover the raison d'être for some of our broadcasting stations. We are told by some newspaper men that the use of their broadcasting station for the dissemination of news seems to have actually decreased their circulation, besides costing them at least $25,000 a year for maintenance. There has been some talk that soon there will be no more broadcasting licenses issued and they don't want to be on the outside when such a situation arises: It may turn out that broadcasting will prove profitable at some time in the future. Why does a street railways system, for example, want to operate a broadcasting station? It is difficult to see how it will make people ride in the street cars any more, as a result of the operation of the company's station.

To the ordinary business man there is one type of station that might give a real reason for existing, that is, the station which attempts to pay its way by renting its facilities to clients who wish to have their name and products gently called to the attention of a shy public. It is very interesting nowadays to observe the advertising salaams and bows made to the broadcast listener before the brand of coffee or batteries is mentioned. It makes the listener quite appreciate himself to notice the deference



SWEDEN'S NEW RADIO TRANSMITTER

At Grimeton, near Gothenburg. The four hundred foot towers extend in a line for a mile and a half. This station is one of those in constant communication with Radio Central at Rocky Point, Long Island. All these stations use high power and a wavelength of approximately 17,500 meters (about ten miles long)

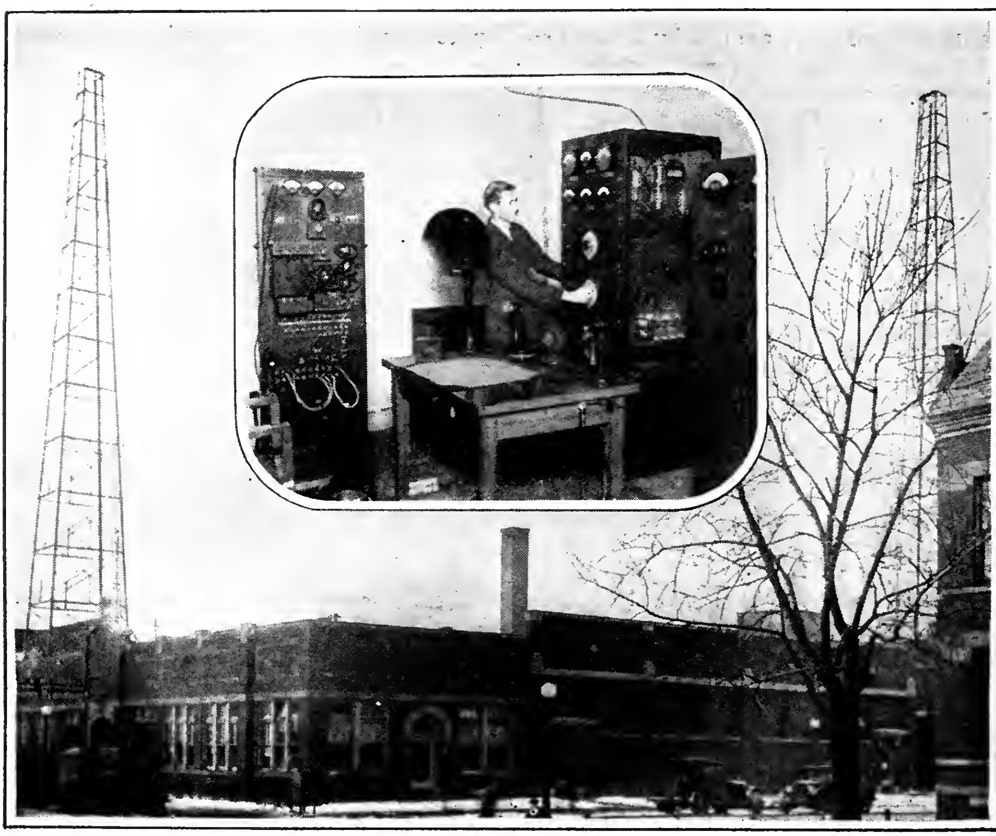
with which his attention is called to the antics of soapy twins or happiness vendors. It seems likely that a new brand of psychology will soon be offered in college curricula—that of the unseen audience.

New York has a station which thus endeavors to increase the sales of candy, cigarettes, soap and what not; Los Angeles has one, and now Chicago has started out on the great adventure. The *Southtown Economist* station, WBCM, is to make the attempt to become self-supporting by commercial advertising of the gentle sort referred to above. This new 500-watt station will be on the air every evening (and possibly daytime too) and will continue its progress until midnight and later. Their program staff will include skilled writers who will get up programs to attract the public's attention to the products they will be asked to buy.

These advertising stations are really not as bad as many listeners anticipated they would be. The quality of this advertising material must continually improve because otherwise people will not listen. So we wish to WBCN success—which will be directly proportionate to the quality of the entertainment it associates with its advertising.

And Now Courtship by Radio

IF YOU can't get married by the regulation courtship methods, try radio. It may be that your voice has such a mellow and appealing quality that if not accompanied by the negative effect of an unattractive physiognomy, girls might fall in love with you. Then, after they've fallen, perhaps meeting you even in person might not be able to shake them free from their love-spell and the battle is thereby won. Then again, whereas one's voice might not be appreciated by the home-folks, in an audience of several hundred thousand there may be a susceptible Miss who falls for it. This seems to have been the case recently when the dulcet tones of Mr. Thomas



A NEW CHICAGO BROADCASTER

Station WBCN, operated by the *Southtown Economist*. The owners of this station plan to attempt toll broadcasting, such as is done by WEAF and other stations

Malies (of Pittsburgh) penetrated the New York apartment of Miss Dorothy Hess (of Chicago). A short time afterward they met and were married, and lived happily ever after, we suppose.

HOW RADIO RESISTANCES ARE WOUND

This precision machine which was in operation at the recent Chicago radio show made strips of resistance varying from three to seven hundred ohms. Like other components in radio receivers, most resistances are wound by machinery, very accurately and quickly

Canadian Stations Joined by Wire

WE KNOW with what success the broadcasting network in the United States is gradually being extended. At first it was only a Presidential address, or event of similar national importance that seemed to warrant the use of a large wire network to tie in several broadcasting stations, but continually increasing interest in broadcasting and continually increasing excellence and utility of programs makes it a foregone conclusion that the association of wire networks and radio stations will be of ever increasing occurrence.

Canada has now entered into this field and for the first time three of her stations were recently tied together to radiate the same program. In Canada, it appears that the railways have been most influential in forwarding radio broadcasting. The Canadian National Railways has offered much of the best material which has been broadcast in Canada including musical, educational, and utilitarian subjects. The railways have also installed receiving equipment in their best trains, so that travelers are kept reasonably well in touch with national events as they speed across the continent.

This first tie-in experiment involved stations in Montreal, Ottawa, and Toronto, and the program was sent out from CNRM in Montreal, when an able address was made by Sir Henry Thornton, president of the company.

Radio and the Church

A NEW YORK newspaper recently printed an interview with three of the best known ministers there who had been preaching over radio channels for the last year or two. The interviewer sought their views as to the effect of radio on church attendance. The final answer to that question has not yet been given. The best known radio preacher in America, Dr. S. Parkes Cadman, made the interesting comment that his father, who preached continuously for sixty years, did not reach during his whole lifetime as many listeners as the son reaches by radio in a single Sunday afternoon. All three of the preachers interviewed spoke of the vast increase in their congregations, as certified by the thousands of letters received from every part of the country. Wherever these three speak the church is filled to overflowing and many cannot get in to hear them. And because of their eloquence, religious conviction, and sincerity of appeal, radio can never decrease church attendance as far as they are

C. H. MURCHLAND

Telegraph operator for the United Press at the Dayton, Ohio, *Herald* receiving press dispatches by radio broadcasting during a recent storm which struck down press wires. Broadcasting has frequently come to the aid of newspapers in an emergency caused by a storm since it was first used in this connection by the Detroit *News* in 1921

concerned. People come to their churches not so much to get religion as to get the speaker's view on religious questions—they want their religious convictions to be deeply rooted in their inner consciousness and appreciate consciously or unconsciously that these magnetic and powerful speakers can bring this about much more thoroughly than would result from any analysis and study of their own. So that if the evidence of such men is to form the basis of our judgment, we must admit that radio is a great assistant to the church—thousands and thousands who cannot get into the church do nevertheless hear these scholars discourse on Christ's philosophy and examine critically the question as to what things are really worth while in our modern complex life.

Many meetings are held outside of the church doors, says one of the ministers interviewed, to listen to his sermon over the radio at points far distant. Do these radio listeners also attend their own church services? or have they forsaken their own comparatively mediocre leader to listen to one of much greater power? Before we can really tell what effect radio has on church attendance we must interview many of these less gifted preachers whose congregations may have fallen off as rapidly as the metropolitan preachers' have increased. So let's interview the country pastor whose flock can listen every Sunday to S. Parkes Cadman or Harry Emerson Fosdick over the radio channels, what the effect of radio on church attendance has been, and see if his views agree with theirs.

Another Antiquated Transmitter Scrapped

THERE is no doubt that broadcasting is making progress; only last month we spoke of the spark signals from the United States Mail tug *President* in the port of New York carrying on its sometimes heavy traffic by means of a spark set which spilled its energy promiscuously throughout the broadcast range. During the past month the Government has decided, after pressure brought by the American Radio Association, to scrap this outfit and install a vacuum tube transmitter in its place. A 200-watt tube set, which will send out practically all of its energy on one wavelength, will be used to replace the one kilowatt spark set at present used. Orders for the purchase and installation of the tube transmitter have already been placed by the Post Office Department.

Wavelengths Will Not Be Changed

THE recent National Radio Conference recommended to the Secretary of Commerce certain changes in the assignment of wavelengths to the various broadcasting stations. It was the opinion of the conference members that interference could thereby be lessened. Soon after the conference disbanded, it became evident to officials of the Commerce Department that the suggested plan had already become obsolete, because of the rapidly increasing number of broadcasting stations, and the consequent demands for wavelength assignments. The present "rush to broadcasting" will not continue very long according to the ideas of some of these officials, and any change in wavelength assignments had better wait until that time.

The complete upset of the re-allocation plan has apparently convinced those responsible for radio regulation that the art is changing so rapidly that a general re-assignment at this time would be useless and should not be attemped until the conditions in the broadcasting world have become more stable. We are inclined to agree with one official who expressed the opinion that many people are getting broadcast licenses who don't want them, and that as the art progresses the number of stations will decrease rather than increase, thereby automatically eliminating

much of the interference which caused the recent radio conferees to suggest the wavelength changes.

The High-Power Arc Loses Favor

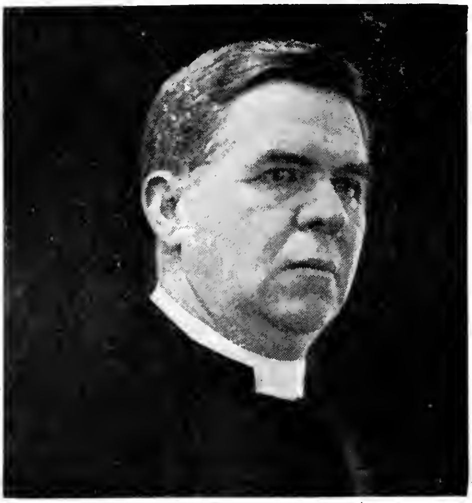
AFTER the General Electric Company secured the contract for the installation of a high-powered tube telegraph transmitter at Mare Island, California, it seems sure that the day of the high-powered arc station has gone. There have been available two methods of getting large powers (in hundreds of kilowatts) for continuous wave telegraphy: the high frequency alternator developed by Fessenden and Alexanderson, and the oscillating arc developed by Poulson and Pedersen and built in America by the Federal Telegraph Company. The Navy Department has installed large arcs for its principal transmitter, and they have proven very effective and reliable in their operation.

The arc is not, however, a very efficient generator of high frequency power, feeding into the antenna, as it does, less than half as much power (in the form of alternating current) as is delivered to the arc itself in the form of continuous current power. Because of its low efficiency, great quantities of water must be circulated around the arc and through the electrodes to keep it sufficiently cool. This defect, of course, doesn't worry the broadcast listener at all, but another characteristic of the high-powered radio arc is very obnoxious to those radio listeners who happen to live within a few miles of such a station. Besides sending out its own wavelength (and another one quite close to it called the compensating wave) the arc sends out an appreciable amount of power at all kinds of wavelengths some of them right in the broadcast channels. These stray wavelengths do not come in the broadcast receiver as pure notes but as noise or "mush". So exasperating is this interference that the great Navy arc at Annapolis shuts down two hours each evening so that radio listeners in that part of the country can avail themselves of the entertainment sent over the broadcast channels.

It has been known for two or three years

BROADCASTING THE MAKING OF A MOTION PICTURE

In a New York studio. Vincent Lopez is at the left with the baton and Ann Pennington is dancing atop the piano. The dance music, is used in the scenario and it was broadcast by WJZ. The announcer made appropriate explanations while the action for the camera was going on



DR. S. PARKES CADMAN
Pastor, Central Congregational Church, Brooklyn

"The scope of my Sunday broadcasting has been greatly extended. . . . Thousands of letters of appreciation come to me from the Eastern States. And when I visit the cities, towns, or villages throughout this vast region I not only meet people who listen regularly to my sermons but who are familiar with my voice.

"We are coming to understand more fully the possibilities and limitation of broadcasting. It is a fascinating problem which well repays study and analysis. If one uses the radio merely to preach special doctrinal views he will fail. On the other hand, if he uses radio to broadcast the great basic principles of religion and of the welfare of the world, he finds in it an agency of unprecedented value."

now that large water-cooled triodes could effectively replace the arcs, and now this change is actually going to take place. Four 20-kilowatt triodes operating in conjunction with each other to feed power into the antenna will replace a 300-kilowatt arc and will permit more satisfactory and reliable communication, according to the engineers responsible for the new installation. But from our standpoint, the beauty of this new triode outfit to replace the arc is due to the absence of "mush". The oscillating vacuum tube is practically free of those spurious oscillations which are responsible for the great interference which the arc causes, and for this alone the radio listeners are truly grateful that the Government is to scrap its antiquated arc transmitters and to keep in line with the march of radio.

Hoover Not For a Radio SalesTax

RECENTLY a Washington dispatch, which at once received wide publicity, stated that in an interview Secretary Hoover had proposed a two per cent. sales tax to support radio broadcasting. Such a proposal at once brings up all sorts of difficult questions, such as, how to enforce the collection of the tax, and still more difficult, how equitably to distribute it. So it seemed that the eminent engineer-Secretary was becoming more of a theorist than an engineer. The truth was, however, that the Secretary did not make the suggestion attributed to him, neither was he in favor of agitation in behalf of such legislation. We believe that a sales tax or a licensing scheme is not the way that the cost of broadcasting is to be met in America. We have yet to find it.

Interesting Things Interestingly Said

WILLIAM A. BRADY (New York City; theatrical producer, speaking about the recent broadcasting by stars of the Metropolitan Opera Company, and others): "Radio constitutes the greatest menace the theatre has ever faced, and so far as I know, the theatre is doing nothing whatever about it. I am seated now in a room with a group of people and we are listening free of charge to a concert which I can only describe as gorgeous. Why should any one be foolish enough to go to a theatre under such circumstances? The trouble is not with those who sit at home and hear McCormack and Bori; the fault is entirely with men who control the theatre.

"We engage these various artists and pay them to work for us. Why should they be permitted to ruin our business by giving free radio entertainments on the side?"

DAVID SARNOFF (New York City; vice-president and general manager, Radio Corporation of America, speaking about coming events in radio): "Within a reasonably short period of time it will be possible for people in New York or London, or people in the United States and England to converse with each other by radio telephony across the ocean. . . . We know how to build sending machines that will send messages and carry the human voice. We also know how to build receiving apparatus which will receive these waves on the other side. We know how to perform stunts in radio photography and the like, but we don't know much about what happens between the send-

ing and receiving machines in the great outdoors that separates them. There's where we must look for additional information."

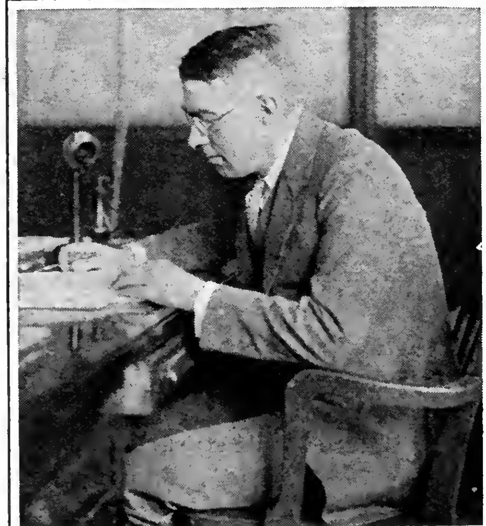
JOHN McCORMACK (New York; phonograph recording artist and concert star, speaking of his impressions after broadcasting for the first time): "I like it. You know I have had plenty of experience in making records, but this beats it. Somehow you seem able to visualize an audience better in broadcasting and you can sing to them directly. After you get the hang of it, it's easy."

LUCREZIA BORI (New York; Metropolitan Opera Company, speaking of her first broadcasting experience): "Oh, I just thought of those 6,000,000 people out there somewhere listening and I was scared to death. I generally sing to four or five thousand and it's very different. It's odd what a feeling you get when you see that little instrument in front of you. I had to fight to keep myself from tightening all up, but after I got well started I forgot all about it."

JUDGE S. B. DAVIS (Washington; Department of Commerce): "The short wave has found its place in commercial and amateur transoceanic communication and in transmission both at home and to places across the seas. In domestic use it is a rival of wire interconnection. I consider interconnection, in whichever mode effected, almost essential to the future of broadcasting if we are to look at radio as a means of service to all our people all the time. It ultimately means national programs, nation-wide utterances, more valuable subject matter and that great happenings in which our people have so vital an interest will be available to everybody. . . . It is transforming broadcasting from a local to a national service."

S. O. MARTIN (New York; president, Sonora Phonograph Company, Inc.): "There has recently come an increasing demand for phonographs and radio-phonographs. We believe that phonograph companies must make a proper connection with the radio industry, since the situation in regard to radio is not at all a question of whether or not the phonograph business will be extinguished by radio, but on the contrary how far the phonograph business can safely ally itself with radio. . . . Now that radio is being dressed up in appropriate cabinets, it is becoming a drawing room feature instead of an attic experiment."

A. H. SCOVILLE (Cleveland; vice president of the Union Trust Company, coöperators with the Goodrich Rubber Company, owners of station WEAR): ". . . In establishing our broadcasting station, we have attempted to demonstrate that radio broadcasting to-day is an important cog in the industrial machinery of our country. I really feel that broadcasting, in its importance, is second only to the introduction of rural free delivery for the farmer, and I make that statement advisedly because with our own broadcasting station we have placed the farmer in the position of a man with a private bond ticker in his office. . . . We look on our station as a means of knitting together the Fourth Federal Reserve District with all its banks and all its people together into a compact whole. We try to keep them thoroughly informed at all times of the major news of the financial world."



GEORGE C. FURNESS

New York: Chairman Battery Committee, Associated Manufacturers of Electrical Supplies

"The responsible manufacturers of dry B batteries have made such marked improvement that to-day's dry B battery operating costs are at least fifty per cent. lower on the average than those of a year ago. The reduction is greatest on those sets with a heavy B battery drain. Here the costs are often only one third of the former figures. A year ago it was sometimes necessary to renew B batteries after two or three months' use. To-day, under the same conditions, they will last from four to six months. These developments resulting in lower operating costs for the radio public have come about in several ways. There has been a real improvement in the design of the regular size B batteries which has brought about greater uniformity and longer life. In the second place, extra large batteries, that is, those constructed with extra large cells, have been developed for use with the increasingly popular multi-tube sets and power amplifiers. Finally, the price of batteries has been reduced."

FIG. I
A panel view of one of the first test models. The final form is practically the same with the exception that one rheostat instead of two controls all the tubes

A Good Four-Tube Receiver

Employing Neutralized Radio Frequency-Amplification, a Controlled Regenerative Detector, and Two Stages of Audio Amplification—An Efficient and Simple Receiver Using Cylindrical Inductances Which Can Easily Be Built

By McMURDO SILVER

THIS receiver is no great innovation in the point of circuit design, for it employs the tried and true principles of radio-frequency amplification and controlled regeneration. As Mr. Silver brings out, his receiver is quite like the one known as the Knockout Roberts receiver, but this set uses cylindrical coils which, for some constructors, may be somewhat easier to build. The receiver produces results, for those in our laboratory on test, quite came up to the promises made by the author. The set has also something in common with that described by G. H. Browning in Radio Broadcast for December. Every part of the Silver receiver can be purchased in the open market and built and assembled by the constructor.—The Editor.

DURING the last year and a half, there is no question but what the super-heterodyne receiver has been at the top of the list, from the point of view of the more experienced set-builders, but for those experimenters who desire "super" results on a small antenna, there have been only two other really satisfactory receivers to turn to, until the advent of the Roberts Knockout Reflex. These receivers were the neutrodyne, or those using some form of tuned radio-frequency amplification, and that good old stand-by, the now almost prehistoric regenerative receiver. The neutrodyne, after the "super", was the next most sensitive receiver, and with these two at the head of the list, the regenerative circuit has suffered a gradual decline in popularity. Now, however, there is a tendency to combine regeneration and r. f. amplification, and receivers built along these lines may in time, supplant both the straight regenerative receiver and the neutrodyne.

The reasons for this are very excellent ones. Tuned r. f. amplification offers many advantages, but the sensitivity of a receiver employing this type of amplification is not as great as it might be if the set itself is to be kept in a stable operating condition. This is because regeneration, unless it be controlled to some extent cannot be used. The sensitivity of such a circuit depends in a very large measure

upon the amount of regeneration used. The obvious thing to do is to combine some form of variable regeneration with stable radio-frequency amplification. If the r. f. amplifier is neutralized and the regeneration take place in the detector circuit, the result is an extremely sensitive, non-radiating receiver. In the more congested centers, the effect of the "bloopers" or radiating receivers is not becoming a menace, but *is* one, and most seriously interferes with satisfactory reception of broadcast programs.

The set to be described herein presents nothing radical nor does it incorporate any wild or so-called new ideas. It is, on the contrary, merely an application of sound design principles in an endeavor to produce a receiver which would embody all the advantages of the neutrodyne plus those of the regenerative receiver and with none of the draw backs of either type. Certain definite requirements were laid out before development was started:

1. The receiver must, when using a 75-foot outdoor antenna give results equivalent to a good seven-tube super-heterodyne when operating on a loop, with respect to sensitivity, selectivity, quality of reproduction, ease of control and simplicity of assembly.
2. The set must employ a minimum number of tubes operating at maximum efficiency.
3. It must be non-radiating.
4. The equipment used must be as efficient as it is practically possible to make it.
5. The construction and assembly must be simple enough for any one to build.
6. The parts cost must be kept within reasonable limits.
7. An extensive course of "trouble-shooting" must be absolutely unnecessary. In other words, the set must work, if it is assembled properly, without trouble and experimenting on the part of the builder.

The general design is shown in Figs. 1 and 2. It will be noticed that the mechanical requirements come up entirely to what was planned for it. As for results, with the set located in Chicago operated with a 75-foot out-door antenna, stations on either coast may be brought in with loud speaker volume on the four tubes while all the locals are operating. Practically all tests of the receiver were conducted in a location midway between WEBH and WQJ, located approximately one-half mile apart. It was entirely possible to bring WGY operating on 380 meters through WEBH operating on 360, with no interference and it was possible to bring several 440 meter stations through WQJ operating on 448 with only a slight amount of back-ground interference. On the lower waves the selectivity was sufficient to separate KFNX, KFKX, WJJD, WTAY, and WTAS, all operating within a very narrow wave band. The selectivity was almost up to that of a seven-tube super-heterodyne and the volume with the out-door antenna was equivalent to that obtained with the "super" on a loop.

WHAT THE SET DOES

ADDITIONAL tests were then made to determine what the set would do on a 20-foot indoor antenna, and most satisfactory results were obtained—stations throughout the country being brought in with ease and in the case of all the more powerful ones, with loud speaker volume. The set was also tested for radiation and it was found that with the detector oscillating and beating on a given station that the same station could be picked up on a super-heterodyne about 25 feet away with no evidence that the four-tube set was oscillating.

The circuit employed consists of one stage of tuned r. f. amplification followed by a regenerative detector and two stages of audio amplification. The r. f. amplifier is neutralized to prevent oscillation and radiation, although where 199 tubes are used it is often

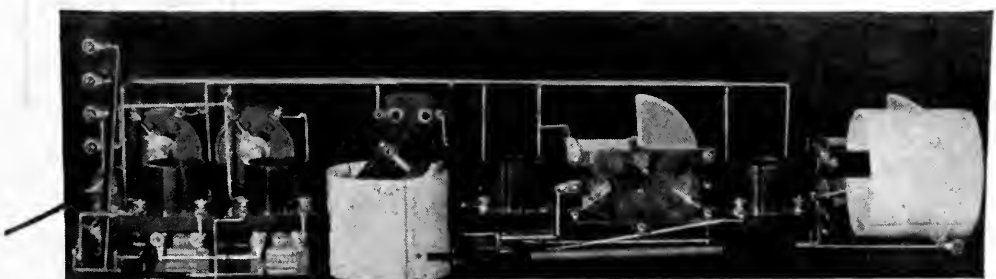


FIG. 2

The "works" of the four-tube set built by Mr. Silver. Note the connection of the neutralizer to the tap off of the vario-coupler secondary coil. All the parts are mounted on the panel and no baseboard is used

unnecessary to neutralize the set. The quality of reproduction was all that could be desired, either with storage battery or dry cell tubes and the difference in volume between 199's and 201-A's was only about 10 per cent., the sensitivity remaining substantially the same. See Fig. 3.

The tuning inductances used in the set are very efficient. I believe they have about the lowest losses of any coils at present used for broadcast reception. They are supported entirely on air with the exception of the two bakelite strips which are approximately ½ inch wide. The turns are held in place by means of five strips of adhesive tape which introduce practically no additional losses. Some tests were run off using the coils with and without a bakelite supporting tube and it was found that the sensitivity to weak signals using the air core coils was decidedly superior to that obtained when coils wound upon a bakelite tube were used. The coils are so located that a minimum of loss from surrounding material is introduced. Some question might arise in the mind of the reader when it is seen that one of the audio transformers is very close to the second detector grid circuit coil, but the losses introduced here are negligible, however. This would not be the case if the transformer were located at one of the open ends of the coil.

The entire assembly of the set is on a 7 x 24 bakelite panel. No sub-base is used. All parts are screwed directly to the panel itself which is extremely substantial and simple. At the left end of the panel is the r. f. tuning condenser which tunes the grid circuit of the r. f. amplifier. Next is the detector tuning condenser controlling the grid circuit of the detector tube. These two controls function in exactly the same manner as the first two controls on a neutrodyne receiver and may be logged in exactly the same fashion. The third control, or tickler, is what accounts for the extreme sensitivity of the set as it provides a means of varying the amount of regeneration used in the detector circuit.

THE PARTS REQUIRED

THE material used by the author to construct the set is as follows:

- 2 .0005 low loss condensers (Silver, Cardwell, or Duplex)
- 1 Low Loss coupler
- 1 Low Loss Antenna coil
- 4 Hoosick Falls panel mounting sockets.
- 1 Howard 6½ Ohm rheostat
- 2 Thordarson 3½:1 Transformers
- 1 Carter 102-A Jack
- 1 Carter 101 Jack
- 1 On-Off Switch
- 1 .00025 Mica condenser with leak clips
- 1 .002 Mica condenser
- 1 .0075 Mica condenser
- 1 2-Megohm grid leak
- 6 Insulated top binding posts
- 3 4″ moulded dials
- 1 7 x 24 x 3/16″ bakelite panel
- 1 5″ length ¼″ brass tubing, spaghetti, lugs, bus bar, solder, etc.

Tools: Screw driver, pliers, soldering iron and hand drill with drills and counter-sink.

If the builder wishes, he may substitute other parts than those specified in the construction of the receiver, bearing in mind that they must be of as good quality as those specified and of approximately the same size and values.

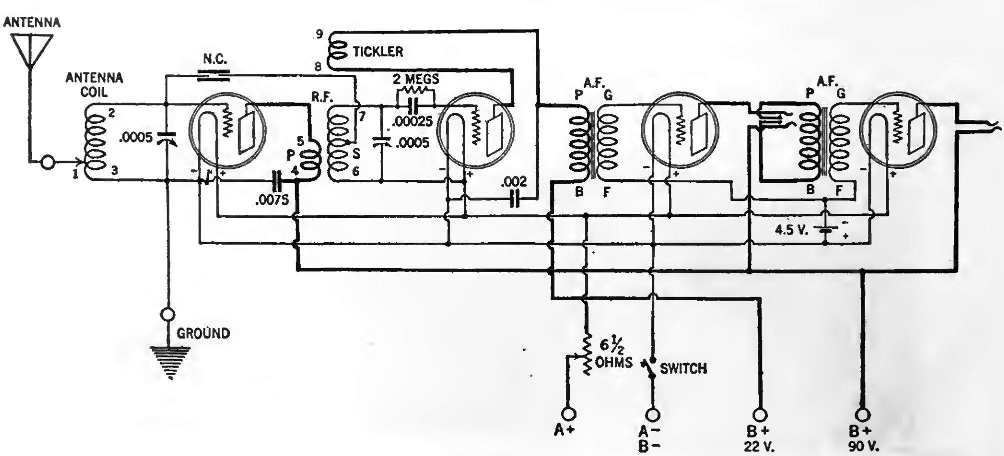


FIG. 3

The schematic circuit diagram. The various coil terminals are numbered for ease in indentification of wiring. Direct reference may be made to the numbers in this plan and those in Fig. 4

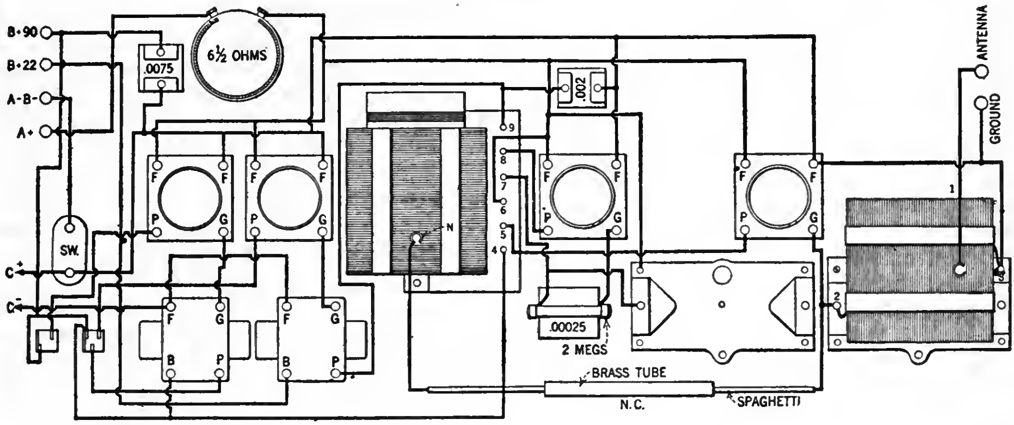


FIG. 4
A picture layout of the wiring. The parts are in relatively the same postion as shown in Fig. 2

Before starting with the assembly and immediately after the purchase of parts, they should be carefully checked and inspected to see that they are in first class condition. All bolts, screws, and springs should be tightened up so that no trouble will be encountered further on in assembling the set.

The panel should be laid out with a scriber and square following the diagram given in Fig. 5 if material as specified in the parts list is used.

After all holes have been located they should be drilled and counter-sunk where necessary. If desired, the panel may then be given a sanded finish by rubbing in one direction only with fine sand paper and oil until all traces of the original polish have disappeared.

DETAILS OF CONSTRUCTION

IF THE builder decides to wind the coils used in the set, the simplest method of doing it is to wind them upon a bottle approximately 3 to $3\frac{1}{8}''$ in diameter and then break the bottle away from the coil. The method of doing so is to place five strips of adhesive tape lengthwise along the bottle, these strips being held down by two rubber bands at either end, the sticky sides up. Sixty turns of No. 20 double cotton-covered wire should be wound in place for the antenna coil with a tap taken at the fifteenth turn, the rubber bands may be removed and the ends of the adhesive tape, each strip of which should be approximately 6 inches long, may now be bound back over the coils to hold the turns in place. This will leave five bands of tape, each one running around both inside and outside of the coil and touching each turn on the inside and on the outside of the winding.

The stator coil of the vario-coupler is wound in exactly the same manner except that at one end of the tube fifteen turns of No. 30 d. c. c. wire are first wound on the bottle and then sixty turns of No. 20 wire put on over this. These fifteen turns are wound single layer, as close together as possible, and the 60 turn winding of No. 20 d. c. c. is put on starting directly over the first turn of the No. 30. When fifteen turns of the stator-secondary winding have been put in place, a tap is taken as on the antenna coil and 45 more turns then put in place. The tickler consists of a small bakelite tube approximately 2 inches in diameter and 1 inch long arranged so that it may be rotated at the end of the last coil made which is the farthest from the tap. The tickler should consist of between fifteen and twenty turns of No. 30 d. c. c. wire.

A more satisfactory way of supporting the coils would be to paint them with a good grade of insulating dope. In order to keep the losses low, however, an extra good grade of dope should be used. If the coils are made in this manner, 55 turns in the grid windings will be sufficient, instead of 60 turns, as the insulating compound increases the distributed capacity slightly.

For the vario-coupler two strips of bakelite may be used to clamp the stator coil together and they may project somewhat at one end. These two projecting ends may have a hole drilled through them which will accommodate a shaft to which the tickler coil is attached. Terminals may be machine screws run through one of the pieces of bakelite strip

which should be wide enough to project to about the edge of the coil whereas the strip inside the coil will be only $\frac{1}{2}$ inch wide.

ASSEMBLY

THE assembling may then be started by placing lugs on all instrument binding posts and mounting the parts themselves upon the panel following the scheme of Fig. 4. No wiring should be attempted before the builder has first studied the lay-out carefully and has turned the lugs in the directions which will permit of the shortest possible connecting wires. After this has been done, the variable condenser, coupler, and rheostats should be removed from the panel and the filament wires put in. These wires should be run along the panel at a point about two inches above a line passing through the socket bases. Small lengths of bus bar should be soldered to the main lines and carried down to the lugs on the sockets. It is advisable to cover this wiring with spaghetti. The antenna coil which has been previously wound should now be placed between two thin strips of bakelite about $\frac{1}{2}$ inch wide and $3\frac{3}{4}$ inches long. In the end of each of these bakelite strips a No. 18 hole should be drilled, placed $3\frac{5}{16}$ inches between centers and arranged so that when one strip is placed over the other the holes at either end will coincide. If $1\frac{1}{4}$ inch round head $\frac{6}{32}$ machine screws are put through these mounting strips at each end with a nut on the far side of the second strip, it will be possible to clamp the coil between the strips which rest on the winding at a point directly above one of the lengths of adhesive tape.

It will be noticed on the condenser that there are two holes used for small mounting screws on the back plate which are approximately on a line which would run through the rear shaft bearing. These screws should be removed, and after a second nut is placed on each of the $1\frac{1}{4}$ inch screws running through the coil mounting strips, these two new screws should be inserted in the holes in the condenser from which the original ones were removed. They may then be tightened up, care being taken to keep the nuts loose upon them until they have been entered at least $\frac{1}{4}$ inch into the condenser end supports. One nut on each screw may then be tightened up against the condenser end plate, and the second nut on each screw tightened up in the opposite direction against the bakelite strip. This will leave the coil clamped firmly between the two bakelite strips and mounted on the back of the condenser. In connecting this coil to the condenser, the end near the tap should go to the frame of the condenser if it is of the grounded rotor type and the end farthest from the tap should go to the stator plates, which will in turn go to the grid of the r. f. tube. The tap itself leads to the antenna binding post.

It is very much simpler to purchase the coupler completely built up than to endeavor to build it, since its construction will involve the turning out of a special shaft, bearings and lock washers. For this reason it will not be taken up, although the winding data has previously been given, and if the constructor feels confident of his ability to build it, he will have sufficient knowledge to supply the mechanical coupling arrangement details suitable for his needs.

The r. f. condenser with its coil is then mounted at the left end of the panel and the detector condenser placed in the next position to the right, followed by the coupling unit which is located between the detector and first audio tube. The rheostat is also put in position and wired with one of its terminals to the positive A battery binding post and the other to the line connecting the positive filament terminals of all sockets. The balance of the set wiring presents no particularly difficult features and if care is used, a very neat job can be made of it. The stator plates of both condensers should be connected to the grid sides of their respective circuits.

TESTING THE SET

AFTER the wiring and assembly has been completed, the set is ready for test. If 201-A tubes are used, a 6-volt storage battery will be required and a 90-volt B battery tapped at either 22 or 45 volts for the detector. A $4\frac{1}{2}$-volt C battery will also be required for the audio amplifier. If UV-199 tubes are used, the B battery will remain the same, but the A battery should consist of three dry cells connected in series or if extra life is desired, six dry cells connected in series parallel.

The batteries should be connected to the set, and as they are connected no sparking should be noticed. If sparking is noticed it indicates that there is a short circuit in the wiring, which should then be very carefully checked. After the batteries are connected, a single tube should be inserted in the right hand socket and the rheostat just barely turned on. If the phone plug is inserted in the right hand jack a click should be heard and if a finger is placed on the grid terminal of this last tube either a click or squeal should result. If this

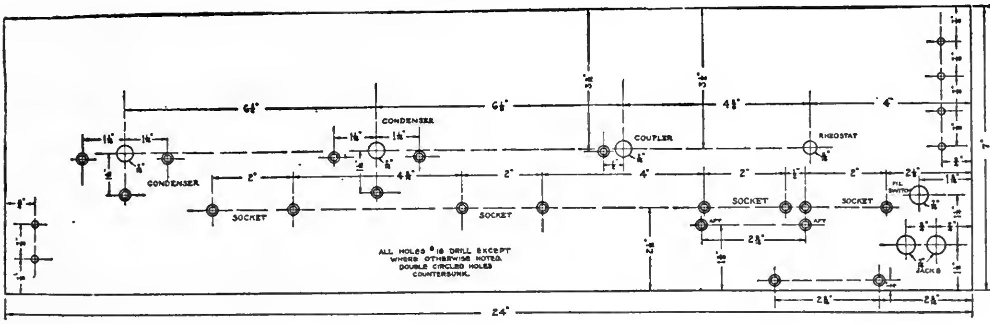


FIG. 5

The panel layout. Where other parts are to be used, it will be necessary to provide other mounting holes. The center holes then may remain as shown

is the case, it indicates that the wiring in this circuit is correct and the second tube should be inserted in the next socket. A click will be heard as it goes in and if its grid terminal is touched, a click or squeal will also be heard. The 2-megohm grid leak should be placed in the clips of the grid condenser and the detector tube inserted in its socket. Then with the detector condenser set at about 50, the tickler should be rotated and as it goes from 0 to 100, at some point along its scale a "plunk" should be heard. If, after this plunk has been heard the grid condenser is touched with the finger, a thud or squeal should result if the detector is oscillating. If the tickler is then set at zero, nothing but a click or squeal should be heard as the grid condenser is touched. If the thud is not heard at all, it is due to failure of the detector tube to oscillate. This may be corrected by reversing the leads to the rotor or tickler coil of the vario-coupler.

Now connect a ground to the ground binding post and an antenna to the small tap located on the stator winding of the coupler which also goes to one side of the neutralizing condenser, which will be connected later. This leaves out entirely the r. f. amplifier tube and gives a straight regenerative detector and two stages of audio amplification. For test purposes, the tickler may now be moved up beyond the point where a plunk is heard and the detector tuning condenser rotated until a "tweet" or squeal is noticed. This indicates a station and if the tickler is then set just below the oscillating point the signal will be heard with its true modulation.

ADJUSTING THE NEUTRALIZER

AFTER these tests have been made, the neutralizing condenser should be connected to the grid terminal of the first tube socket and to the tap on the stator winding of the vario-coupler. The neutralizing condenser consists of nothing more than two pieces of bus bar of equal length and so arranged that when soldered to the tap and grid terminal referred to and running in the same direction their ends will fail to meet by approximately $\frac{1}{4}$ inch. Both ends are inserted in a length of spaghetti which will, when run from the tap up to the grid terminal, serve to hold these two pieces of bus bar firmly in position. Before they are finally soldered in place, a small 5-inch length of brass tubing should be placed over the spaghetti and left entirely unconnected so far as the balance of the wiring goes. This completes the neutralizing condenser.

An antenna should now be connected to the antenna binding post of the set and the first or r. f. tube inserted in its socket. The rheostat should be approximately three-quarters on. The tickler should be set at zero and the tuning condenser at a position where a station was previously heard. The 5-inch brass tube should be pushed up toward one end of the spaghetti tube on which it slides and the r. f. tuning condenser varied around approximately the same setting as that of the detector condenser, when the station should be heard again. Stations should now be tuned-in over the entire range of the receiver, with the tickler at zero.

If the r. f. amplifier oscillates, the small piece of brass tubing should be slid down the spaghetti $\frac{1}{4}$ inch at a time until all tendency toward oscillation is eliminated. If it cannot be eliminated by moving this tubing along, this indicates that the primary of the r. f. transformer is improperly connected and the leads to it should be reversed. This primary is the small 15-turn coil located inside one end of the vario-coupler stator coil.

Another method of neutralizing the set would be to tune-in a fairly strong signal and then remove the first r. f. tube from its socket. A piece of paper should be placed over one of the filament pins and the tube replaced in its socket. Then, with the tube unlit, the signal will come through weakly and the brass tube should be slid along until the signal does not come through at all or at best with very poor intensity.

The receiver having been neutralized, there is nothing more to do, and in tuning it may either be operated with the tickler set at zero and the first two dials handled in the same manner as when tuning a neutrodyne, or the tickler coupling may be increased until the detector oscillates and a signal located by rotating the detector condenser until a whistle is heard. The detector condenser should be left set on the whistle and the r. f. condenser moved to a point where the whistle is strongest. If the tickler coupling is then reduced to just below the oscillating point and the two condensers readjusted very slightly, the signal will be heard with maximum intensity.

De Forest DV-3 tubes, which have the same characteristics of 199's may be used and will work in very nicely as they have standard bases and do not require adapters. WD-12's will also work in very well as they also have standard bases. It is probable that the neutralizing adjustment will not be at all critical if 199's or WD-12's are used.

TROUBLE SHOOTING

THERE is very little that can go wrong with the receiver or that might cause failure to function, and if it is assembled properly, there is no reason why it should not work. However, it is possible gradually to improve it slightly by following some of the suggestions outlined below:

Selectivity: If the detector tuning condenser is broad, it indicates the use of an insufficient amount of tickler coupling. It should be possible to make this control very selective indeed by bringing the tickler up to just below the oscillating point. If the r. f. tuning condenser is broad, this may be overcome by inserting a small fixed condenser, say .00025 or .0005 mfd. in series with the antenna which will, in effect, reduce the resistance of this circuit and sharpen its tuning very much. This will not be necessary except with a very long antenna, say over 125 feet.

Volume: If the detector can be made to oscillate and the receiver to tune sharply, poor volume may be attributed to trouble in the audio frequency amplifier and should be looked for in this section. Improper connections or misplaced C battery, would account for this. Individual location conditions will more probably be to blame, however.

Hand Capacity Effect: This will not be experienced if the stator plates of the condensers are connected to the grid sides of the circuit and if all by-pass condensers are wired in. The by-pass condensers are very important. The .002 mfd. by-pass condenser is quite important and should be connected from the plate terminal of the first audio transformer to either minus or plus side of the filament line.

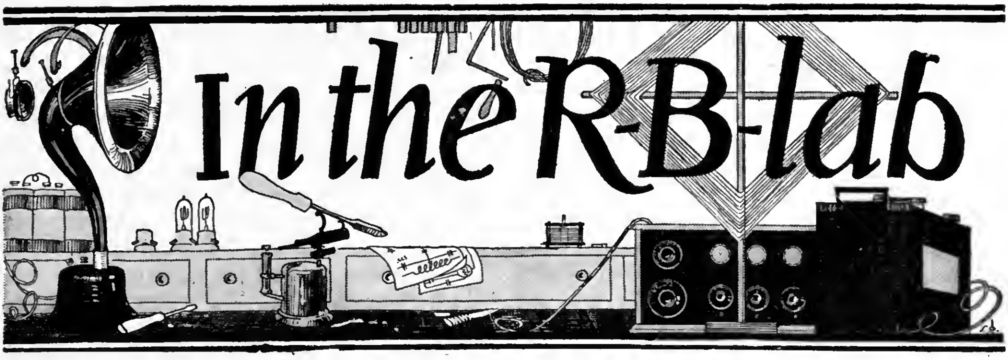
Squealing: This would be due either to too high a value of tickler coupling, failure to neutralize the r. f. amplifier, or more probably to the audio amplifier. If in the audio amplifier, it may be overcome by reversing the leads to the primary of the audio transformers or shunting the secondary of the audio transformers with a .00025 mfd. condenser or $\frac{1}{4}$ megohm grid leak, or both.

Noise: Noise in the set should be traced by first disconnecting the antenna. If it disappears it is picked up on the antenna and probably cannot be eliminated. If it persists, the first r. f. tube should be removed and so on down the line until it stops. If it stops upon the removal of some tube other than the last one, the noise is probably in its circuit. If it persists throughout the entire set it is due to some faulty common wiring, such as B battery, or A battery, rheostat, or socket contact.

Grid Leaks: A 2-megohm grid leak will be satisfactory for practically all tubes used, although it may be found that a 3- or 5-megohm grid leak will give a little better result on weak signals.

Tickler: The detector circuit should not oscillate until the tickler has been advanced to about 50 to 70 degrees on its dial. If it oscillates at some point below this, turns should be removed from the tickler coil until the oscillation point is brought within this range, if the builder wishes to do so, although this is not very important. If the detector fails to oscillate, reversing the tickler connections will correct matters.

Neutralizing: If the r. f. stage cannot be neutralized so that it does not oscillate, the leads to the primary of the r. f. transformer should be reversed. If this fails to correct matters, one or two turns should be removed from the primary, although this would be an extreme case.



APPLYING THE REGENERATIVE LOOP TO ANY SUPER-HETERODYNE

THE principle of the regenerative loop can be applied to practically any type of super-heterodyne receiver without altering the interior connections of the set. The "regenerative loop" is, as the name implies, a method of introducing regeneration into the first detector tube. This results in all the desirable characteristics of the regenerative circuit—i. e., increased sensitivity and response to distant stations, and greater selectivity. (Under certain conditions, such as operating in closed quarters as imposed by steel apartment houses in a large broadcasting center, the selectivity of the super-heterodyne operated in the usual manner falls short of its possibilities. This is due to distortion of the wave front by the surrounding walls and semi-conducting or refracting mediums. As a result, the loop is extremely unreliable as an indication of direction, the plane of the loop often being approximately 90 degrees to the expected angle, and most stations, regardless of direction, are received best at this one position.)

Regeneration in the loop can be effected in several ways. A somewhat common system, though not altogether satisfactory, employs a tickler coil situated within the loop. The adjustment of the tickler, however, affects the tuning of both the plate circuit (which inputs to the intermediate-frequency amplifier) and the grid circuit, when coupling is sufficiently close to secure satisfactory regeneration. A more common and satisfactory method is to alter the loop circuit into a regenerative system. This is a simple matter and quickly accomplished.

It is first necessary to add more turns of wire to the loop, say from one third to twice the number of turns used for normal tuning. A tap is brought out where the new turns connect to the old. The additional turns are wound in the same direction as the loop proper.

In many cases it will be found that the loop the experimenter is utilizing for straight reception has more turns than are necessary to cover the desired wave band and that the tuning condenser is only active up to about two thirds maximum capacity. Where this is true, it will probably be possible to tap the loop so that sufficient turns of wire are left on one side for regeneration. As before mentioned, from one third to one half the number of turns used in the tuning section are required in the additional or regenerative section.

The completed loop will have outlets for three connections, the upper terminal, the near-center tap, and the lower terminal. For simplicity in the

In the R. B. Lab This Month—

—How to apply the regenerative loop principle to any super-heterodyne.

—Using standard low-loss coils in the Roberts Knockout circuit.

—A receiver operating from 45 to 200 meters using the Roberts circuit and low-loss coils.

—A method for pre-determining how to connect the tickler coil in a regenerative circuit.

—Short laboratory notes of value and interest to the constructor and the experimenter.

following explanation, designate these respectively, as A, B, and C. "A" connects to the posts or jack prong on the super which leads through to the grid of the first detector tube, either directly or through the pick-up coil. A short inspection of the receiver will identify this lead. In the case of loop binding-posts, it is generally the upper one. "B" runs to the remaining loop post or prong. The connection leads through to the filament of the first detector tube. The upper part of the loop is now connected in the usual manner, exactly as the whole loop was before the change was considered.

"C" is now connected to one side of a variable condenser having a capacity not less than .00035 mfd. This will be sufficient, though if more convenient a larger condenser may be used. The condenser shown in the photograph (Fig. 1) is a Freshman mercury condenser, capacity .0005 mfd. The other and remaining side of the condenser is connected to the plate of the first detector tube. These connections are shown diagramatically in Fig. 2, where A indicates the usual loop connections in the Haynes and other super-heterodynes, and B the regenerative system.

The experienced reader will immediately identify the resulting circuit as the Hartley system, which becomes an oscillator as the condenser, C_2 is turned above the spilling over point. This system of producing oscillation is used in many transmitting stations. However, the receiving operator, utilizing regenerative loop reception should not permit the detector tube to oscillate. In this condition it is a radiator of interfering waves, which, though they are effective only over short distances, may still bother reception on another receiver located in the same building. Fortunately there is absolutely nothing to be gained by maintaining these oscillations, reception being impossible until condenser C_2 is turned down.

Tuning the "super" is only slightly more complicated with the regenerative loop. As regeneration is built up, a slight retuning of the loop or oscillator dial will be required. Regeneration will be most effective on distant stations.

Fig. 1 shows this system adapted to the Haynes simplified super-heterodyne, described in the March, 1924, Radio Broadcast.

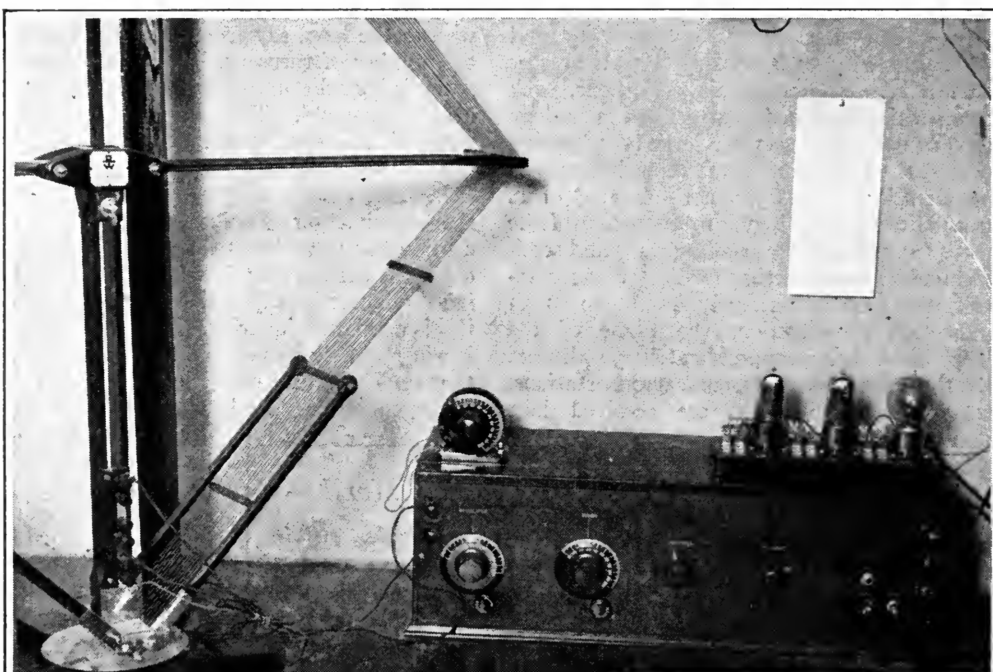
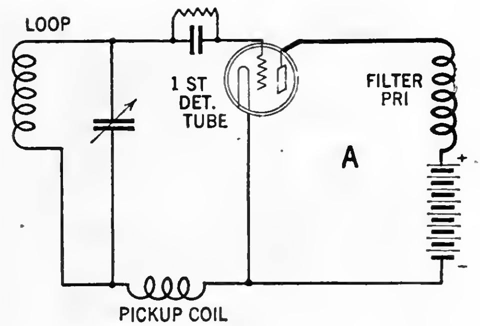


FIG. 1

The regenerative loop in operation. Note the three leads from the loop. The control condenser is above the oscillator dial. Three stages of resistance coupling are plugged in on the detector tube of this super-heterodyne. See January, February, and March, 1924, Radio Broadcast



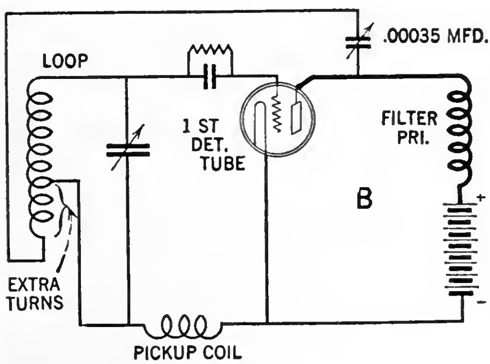


FIG. 2

"A" shows the usual loop connection in most superheterodynes. "B" indicates the additional turns and condenser which cause regeneration in the first detector tube. This arrangement is particularly advantageous on DX reception

LOW LOSS COILS AND THE ROBERTS SET

FIGURES 3, 4 and 5 illustrate the manner in which standard three-circuit low loss coils can be adapted to the Roberts Knockout circuit. In principle, the adaptation consists merely in supplying a neutralizing winding to the radio frequency output circuit. Either one or two low loss tuning units can be employed. If one set of coils is obtained, the substitution is effected only in the r. f. and tickler circuit, the usual spiderweb or similar antenna coupler being unchanged. With two units the complete system is made low-loss, from the antenna through to the audio output.

The units employed in experiments in The R. B. Lab were the "Lopez Low Loss Tuners." The same directions and manner of procedure hold good for other types.

USING ONE UNIT

IN SUBSTITUTING a single set of coils for the usual "N, P, S, and tickler" inductances, the primary of the low loss tuner arrangement is used as the transformer primary (P) and is placed in the plate circuit of the first tube. However, it is first necessary to wind either alongside or on top of the primary coil, the neutralizing winding. This consists of one more turn than the primary, wound in the same direction, with any convenient wire, such as No. 24. The beginning of the neutralizing winding is connected to the end of the primary, thus giving a common tap to the two coils, which is connected to the plus side of the B battery. The remaining terminal of the primary is wired to the plate of the r.f. tube and the end of the auxiliary winding to the neutralizing condenser. The secondary and tickler coils are connected in the usual manner.

USING TWO UNITS

WHEN a duplicate set of coils is employed, the procedure is slightly different. The antenna coupler is formed by removing the tickler coil from one of the units, thus leaving primary and secondary. These two remaining coils may be remounted in numerous ways that will suggest themselves to the experimenter. The tickler that has been eliminated from the first unit, is now substituted for the primary of the second unit, and a neutralizing winding wound upon it as already described. The number of turns on the tickler are generally more suited to the transformer primary requirements, than the primary designed for the antenna circuit.

Using these coils, the primary taps are eliminated, as the antenna primaries are generally of the semi-aperiodic type. The ground, in addition to running to the lower end of the primary, should be connected to the minus side of the A battery.

Figs. 3, 4, and 5 show how the coils used in this laboratory were mounted. Low loss coils are generally more bulky than the less efficient inductances, for which reason their disposal on the panel presents more of a problem. The shaft to the transformer primary (the upper coil in Fig. 4) has been removed, as there is no occasion for varying the coupling between the primary and secondary, and it is secured permanently by means of a metal strip. Other forms of winding, such as the diamond weave and spiderweb may be satisfactorily substituted tor the basket weave coil illustrated.

A SHORT WAVE LOW LOSS SET

BY SIMILARLY utilizing short wave low loss coils, a highly efficient short wave receiver, similar to that described in the August number of RADIO BROADCAST can be had. A receiver of this type is operating successfully in the R. B. Lab on wavelengths between 45 and 200 meters. It was used in intercommunication work with amateur stations for checking up on European reception during the International Radio Broadcast Tests.

On the short wave set, the tickler should be so arranged that 180 degree variation is possible. It is, of course, impossible to secure satisfactory reception of short wave telephone broadcasts with the detector oscillating, and on the extremely high frequencies reversed feedback is generally necessary to stabilize the receiver. The tickler coupling must not merely be loosened but the coil must be turned around over ninety degrees.

It is somewhat contrary to expectations, and therefore interesting to note, that the Roberts circuit employing low loss coils, responds more readily to adjustments of the neutralizing condenser, and little or no experimenting is required to stabilize the system. Operating and other instructions remain the same as those suggested for the standard receiver.

For detailed information concerning the Roberts circuit and parts other than those just described, the reader is referred to any of the articles dealing with the set, or the "Knock-Out Book" published by RADIO BROADCAST.

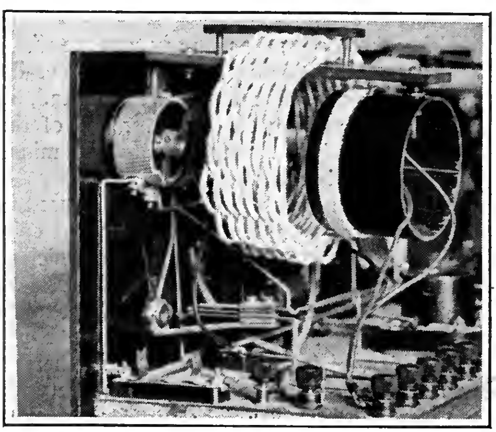


FIG. 3
Primary and secondary low-loss coils for the antenna coupler. These have been remounted from a standard three-coil unit

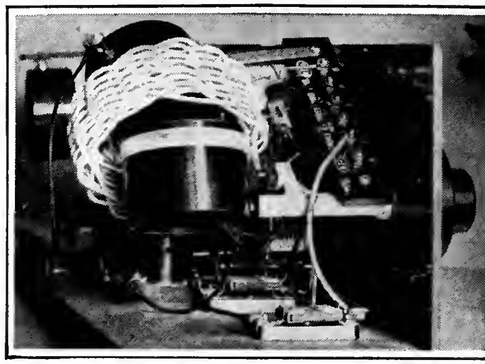


FIG. 4
The r. f. transformer and tickler coil. The primary shaft has been removed, and the coil mounted on the frame by a metal strip

HOW TO CONNECT YOUR TICKLER COIL

ARTICLES on the wiring and operation of tickler-feedback regenerative receivers are almost invariably accompanied by rather indefinite instructions as to the proper connections to the feedback coil. The reader has doubtless run across a phrase (which the writer has often written) explaining that if the set failed to regenerate the connections to the tickler were to be reversed. Thus the wiring of the regenerative apparatus was a fifty-fifty chance which, in consideration of a permanent job, was decidedly inconvenient.

There is really no reason why the exact manner of connecting the tickler coil should not be stated, for all doubt can be eliminated by a simple rule.

Regeneration is secured by tickler feedback when energy is fed back from a coil in the plate circuit of a vacuum tube to a coil, generally the secondary of a vario-coupler, in the grid circuit, in such a manner that the returned impulse is in the same or assisting direction of the existing grid impulse. When the directions are reversed, that is, when the feedback impulse is in a direction opposing the grid impulse, the effect is naturally reversed, and instead of regeneration we have a very noticeable weakening of the signal.

To one familiar with the laws of induction, these considerations will throw light on the situation. Let us assume that the incoming signal places a momentary positive charge on the grid. This will, of course, cause an increase in the plate current, with an expansion of the magnetic field about the tickler. This

motion of the flux will induce an appreciable e.m.f. in the secondary coil if the coupling is sufficiently close. If regeneration is desired, this e.m.f. must be such as to place an additional positive charge on the grid which assists the original charge. However, we know that an induced current is always in a direction opposite to that of the original or inducing current at moment of induction. This brings us to the very simply rule which may be relied upon to guide tickler connections rightly.

Take any regenerative circuit, and consider two distinct currents as flowing from the tube, one from the grid, through the grid coil or secondary to the filament, and the other from the plate, through the plate coil and battery to the filament. (These conditions, in an electronic analysis, often exist during reception). The drawings in Fig. 6 illustrate this conception of the two individual currents flowing from the grid and plate of the tube, the arrows indicating the direction of flow as we have suggested. The rule is (bringing the coils close together) that these two currents must flow in opposing directions—i.e., one set of arrows must point up and the other set point down.

The rule is further qualified as follows: When the coils are wound in the same direction (A) either clockwise or counter clockwise, the grid must connect to the beginning of the grid coil and the plate to the end of the tickler or, of course, vice versa. When the coils are wound in opposite directions, the grid and plate should connect both to either the beginnings or ends of their respective coils.

B, in Fig. 6, shows two coils wound in the same direction in which the requirement for regeneration has not been filled. The effect of this coupling, as explained, will be the opposite of regeneration.

LABORATORY HINTS

THE capacities of condensers used in radio circuits are generally given in microfarads, which means one millionth of the unit of capacity, the farad. The abbreviation for microfarad is "mfd." Thus, we often run across condenser specifications such as .001 or .0005 mfd. There has been a recent tendency to eliminate the decimal, and to consider these small capacities in micro-microfarads, or millionths of a microfarad. The abbreviation for this term is mmfd. Condensers having capacities of .00025 mfd., .00035 mfd. .0005 mfd. and .001 mfd. can be respectively described as 250 micro-microfarads, 350 micro-microfarads, 500 micro-microfarads, and 1000 micro-microfarads condensers.

AN EXCELLENT reamer for working panel material is a round file, $\frac{3}{8}$ inch in diameter at the large end. Enough of the tang is broken off so that the file can be grasped in a brace. Any hole in which the point of the file can be inserted can be reamed up to $\frac{3}{8}$ inch by turning the brace

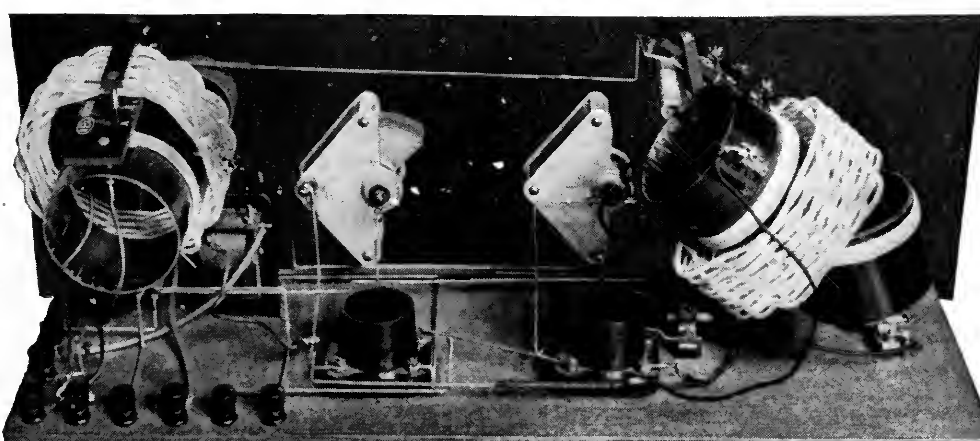


FIG. 5
Rear view of the low-loss Roberts, using adapted Lopez Tuners. This set is particularly easy to neutralize

counter-clockwise. If turned clockwise it will jam.

Holes reamed in this manner are very smooth and have little taper.

IN THE article on charging storage B batteries in the June RADIO BROADCAST, mention was made of the discrepancy between a hot wire meter and a d.c. meter in a common charging circuit. The a.c. meter will always give the higher reading, and a statement was advanced that this reading was to be preferred as being the more nearly correct value of the current flowing. This is erronious. The hot wire meter registers the root mean square or heating value of the current, and the d.c. meter the average value of the current. An electrolytic process, such as that functioning in a storage battery during charge, varies with the average current. That is, a two ampere charge applied for one hour, off for one hour, on for one hour, etc., is equivalent in electrolytic effect to that obtained by applying a one ampere charge continuously for the total length of time of the intermittent charge. It can be shown that in a pulsating current, the r.m.s. value is always higher than the average value.

In almost every other case where measurements are desired of a pulsating current, it is the r.m.s. value that should be observed.

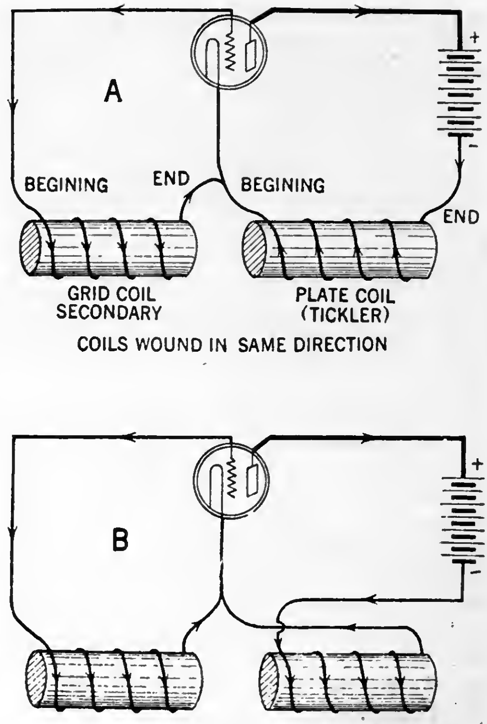


FIG. 6

How to connect your tickler coil for regeneration, in accordance with simple rules set forth in this article. "A" will regenerate. "B" will rot.

Shall We Specify Parts?

The Policy of This Magazine in Publishing Construction Articles—A Note on Radiating Receivers

By ARTHUR H. LYNCH

FOR some little while we have given a great deal of thought and consideration to the interesting subjects discussed in the letter we publish below. Similar questions to Mr. Musladin's have been asked us time and again. The answer is not easy, nor can it be made without reservations. We try to have the articles appearing in our magazine as near correct technically, practically, and ethically as human effort permits. You will find Mr. Musladin's letter of interest, and we will consider it below.

Editor, RADIO BROADCAST,
Doubleday, Page & Co.,
Garden City, L. I.

DEAR SIR:

The writer has been observing construction articles in radio publications and feels that there should be a general movement toward broader specifications of parts.

It is no secret, to be sure, that exact specifications are causing both dealers and jobbers considerable trouble. The layman in reading the articles justly believes that good results can only be obtained by following exact specifications, if exact specifications are published; and while it may or may not be the writer's intent to press that idea, nevertheless the ultimate result is that both dealers and jobbers receive hundreds of requests for materials not stocked in jobbing centers away from manufacturing centers, because of the fact that the particular item is not a nationally recognized standard.

From a personal standpoint I might say that we are very proud of the fact that we carry practically all nationally recognized standards. There is hardly a need of publishing a list of them, but it will suffice to say that such a listing would prove that it is our desire to serve the public in this particular territory with parts to which they should be entitled.

By way of detailed explanation, one might take the variable condenser situation. Is it not a generally accepted fact that the substitution of any of the wonderful examples of condenser construction now on the market will produce like results?

The audio transformer presents another case. Jacks, rheostats, binding posts, and similar items are certainly not subject to exact specifications. In cases where a company has succeeded in producing a very good patented item, and which will prove popular when presented to the public, the right of that company to subsidise, or themselves publish, an article is not questioned. In cases of this kind winding data or construction data should be given.

To come down to the real point of my letter, would it not be possible for editors to adopt some standard expression for use in terminating all such articles? My suggestion is as follows:

The above items were used in the author's described set, but substitutes of equally good materials will produce like results.

You are, of course, in better position to promote such an idea, and I believe you would have the thanks of those engaged in the radio business, and those who desire to see the business as a whole put on a strictly ethical basis.

Very truly yours,
ALEXANDER AND LAVENSON ELECTRICAL SUPPLY COMPANY, San Francisco, Cal.
BY C. P. Musladin, Sales Manager

We try to give the reader every possible assistance in building receivers from the articles we publish. Wherever possible we name the parts used in building the receivers, and where similar units of other makes can be employed with equal satisfaction we say so. We try, as far as possible to describe only such receiving circuits as include parts of reputable manufacture, which may be purchased in all parts of the country. Where special parts, such as the coils for the Roberts circuit and the intermediate-frequency transformers of certain super-heterodynes are recommended, we insist upon authors supplying us with data concerning their construction as well as the names of units which may be substituted wherever possible. We cannot insult the intelligence of our readers by mentioning all the condensers which could be used in a given circuit, for instance. There are a great many good variable condensers on the market any of which—if of proper capacity—would work well in a circuit where a particular brand is mentioned. This is true of audio-frequency transformers, tube sockets, jacks, rheostats, panels, and similar products. As a general rule, any good parts designed for the same purpose may be interchanged in a well designed circuit.

We quite agree with Mr. Musladin. This magazine will continue to print construction

articles, specifying particular parts when necessary, and wherever possible indicating the use of standard products. But, for the time being, we must remember that the market is pretty well flooded with useless and poorly designed parts which we hope to save our readers from buying.

It is true that certain manufacturers subsidize writers to specify their units. Sometimes, perhaps, they are justified in doing so. Such articles are usually taken with a grain of salt by the reader and though they may make some temporary friends for the publication among those whose parts are specified, the usual result is unfavorable reaction on the part of other advertisers. In many instances the periodicals in question do not acquaint themselves with the performance of the receivers described and, as a result, many utterly useless purchases, and general dissatisfaction will result. As an instance of this: an experimenter sent us a very well written and very well illustrated article, describing a five-tube, single-control receiver some few months ago. The work was excellent. We asked for a demonstration. When the receiver came to our laboratory we were delighted with its appearance. Then we tried to make it work. Then we called for assistance from the designer. He tried to make it work. Then he began to make apologies. Imagine our surprise on seeing the description of this wonder appear on the front page of a certain newspaper radio section for which we had come to have a feeling of friendship because of the technical accuracy of the articles it published.

There are occasions, when the subsidized writer—usually signing his articles with a self-imposed "Radio Engineer"—really does describe something worth while and, even if he does load his literary efforts describing it with publicity which is supplemented by price lists and space in the advertising section, the intelligent reader will take it for what it is worth. We are quite certain that advertising contracts, secured by the offer of a certain amount of editorial comment per dollar are hard to renew. We want none of them. On the other hand it is equally unfair to the reader, who, in the final analysis pays the piper, for any periodical to withhold a description of a valuable addition to the radio field because it is not to be accompanied by advertising.

Our policy is governed by the value we believe the article under consideration will be to our readers. If it happens to stimulate the sale of reliable products, we believe it does the reader and the manufacturer a service, by bringing to the former a good product and the latter a customer. In doing this work, however, we try to maintain a perfectly fair stand in connection with products of a competing nature. It is only by such procedure we believe the industry will prosper.

THE BLOOPERS ARE AT IT AGAIN

IT IS rather significant that all of the letters considered here were received in the same mail. If we get many more, requiring such lengthy comment we may have to abandon the magazine and devote all our time to correspondence.

Mr. Guy M. Chase of Elizabeth, N. J., is responsible for the letter which follows, which, with our reply, seems to require no further comment.

Editor, Radio Broadcast,
Doubleday, Page & Co.,
Garden City, L. I.

Dear Sir:

On page 280 of the December issue of Radio Broadcast in an article by A. H. Lynch, there appear statements which are, to me, interesting.

Speaking of the absence of "squealing receivers" at the Radio Fair, the article lists, "all manner of tuned radio frequency receivers, reflexes, and super-heterodynes," with the intimation that they do not squeal.

I know of a certain factory-built five-tube tuned radio frequency receiver in this city, operated on a 100-foot outside antenna which is *always tuned by the squeals*, even on locals. With 90 volts on the plate, is not that a squealer?

Super-heterodynes operated on outside antennas, with a constantly oscillating tube as a part of the working of the set, seem to me to fall in the squealer class, with a vengeance. I know of improperly tuned neutrodynes likewise tuned by the squeals.

I read most of the radio magazines published and I set up and try out a great many circuits. There are few which will not squeal when improperly operated or improperly adjusted, at least, that is my experience.

My point is this. I have been impressed with the fact that most radio magazines are obsessed with the idea that only regenerative circuits *can* squeal. I have often heard a salesman tell a buyer that a neutrodyne set or a tuned r.f. set could not squeal. I think that is sheer fraud.

True, regenerative circuits can be so operated as to be a pest to all for miles around. Those who have recently listened for Europe can swear to that. But not all the squeals come from regenerative sets. (I except the single-circuit from any consideration, as it is, by all odds, the champion squealer.)

Using two coupled regenerative sets, of the so-

called Ambassador type, another person and I have used two antennas which are parallel and two feet apart for 40 feet, one being 40 feet long and the other 100. We tuned all over the scale and neither one of us heard a squeal from the other set. The other operator used a loud speaker and I phones and one a.f. stage. Coupled regenerative sets, like any other, can be operated without squeals.

I ask consideration of this point:

Any set, regardless of name, type, or price, which will produce a squeal in its own speaker or phones, also produces a squeal in near-by speakers and phones.

Very truly yours,
GUY M. CHASE, Elizabeth, New Jersey.

Mr. Guy M. Chase,
Elizabeth, N. J.

DEAR SIR:

Thank you very much for your interesting letter. We have not overlooked the very important matters that you discuss, but Rome was not made in a day and it is impossible for us to do much at one time.

One of the principal reasons for our International Tests was to demonstrate conclusively to the radio listeners that squealing receivers should be abolished. It makes no difference to us whether they be single-circuit or improperly balanced neutrodynes or super-heterodynes hooked up to an antenna.

Thank you for your coöperation.

Very truly yours,
ARTHUR H. LYNCH
EDITOR, RADIO BROADCAST

Then, along with Mr. Chase's letter and several thousand of a similar nature we have one from an old-timer—a man who was for some time a radio inspector for the Marconi Wireless Telegraph Company of America. We felt that editorial expression concerning this letter is a waste of time. No doubt ninety per cent. of you folks listened for Europe during our international tests and it is quite likely that most of you heard the racket to which Mr. Collison refers and no additional reference to the subject is necessary at this time.

Editor, RADIO BROADCAST
Doubleday, Page & Co.,
Garden City, L. I.

DEAR SIR:

On Monday, Wednesday and Thursday nights of the International Test week, friend wife and I aided by a nine-tube super-heterodyne that has just been calibrated by Tyler, Rossiter, and MacDonald of New York City, deprived (and that's just what I mean to say), ourselves of sleep and almost ruined our sense of hearing not to mention our dispositions, in an attempt to pick up some of the European Stations.

And what did we hear?

Promptly at eleven o'clock, four million assorted squeals, whistles, whines, yowls, grunts, rattles. buzzes, ships working with spark sets with a decrement of something more than ten times what is allowed, chirping and twittering amateurs with little five-watt bottles (I dare any member of the A. R. R. L. to deny that his fellow members kept within bounds), and enough static to fill in the weak spots.

It's an outrage—I don't mean the static,—that's sent to us either from Heaven as punishment for our sins, or from Hades to plague us and must be accepted along with Income Tax Publicity, Near Beer, and Subway Rush Hour Riots.

But this oscillating receiver business is something that does not have to be endured. Newspaper publicity has not helped, because the average B.C. L. does not care a tinker's damn about the other fellow. Of what use is it for any person to invest several hundred dollars in a laboratory model super-heterodyne if some hi-jacking neighbor with a "one-tube-marvel" is going to smear the ether with noise.

Although the range of my super-heterodyne with a loop is considerably less than when used on an out-door antenna I would not think of putting it on an antenna because I know it would ruin reception for my immediate neighbors. I live in an apartment with several other B. C. L.'s and none of us annoy each other. That is because we have used our brains in a manner courteous to each other.

There is no way of getting under the skin of those who persistently sell parts which when assembled will cause radiation. They are of the same moral fibre as a bootlegger.

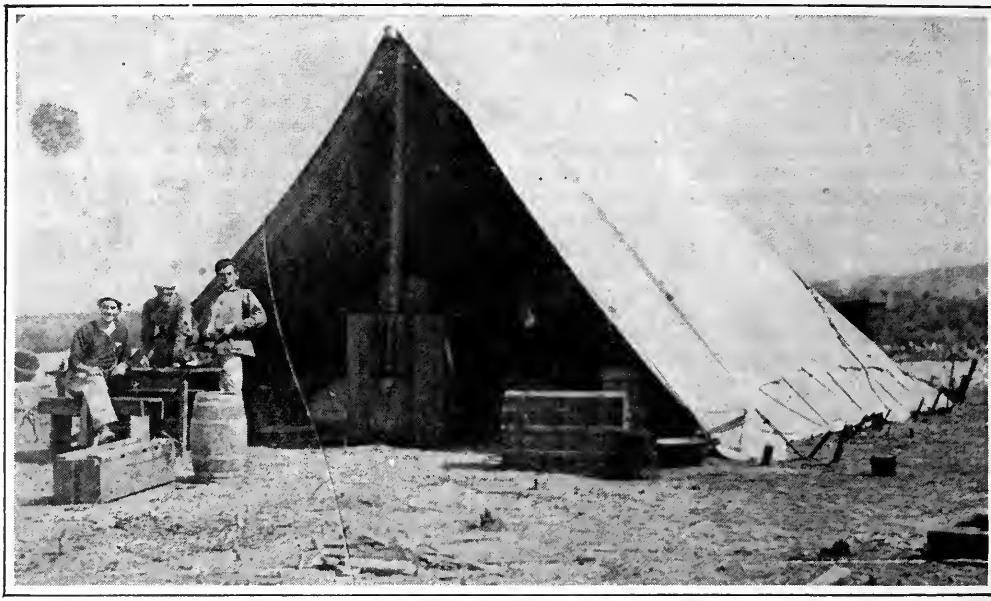
Every receiving set manufactured in the United States should be of a design approved by the U. S. Department of Commerce. All commercial radio apparatus must be so approved, so why not every other kind? This would remedy one source of trouble. Every installation connected to an outdoor antenna should be licensed by the Radio Inspector of that District and subject to his restrictions and orders. A one dollar license fee would not be a hardship and would more than pay for the cost of the extra inspectors needed. Periodic inspections might be arranged to check up the installations.

No doubt there will be many objections to this plan because it will curtail some "personal liberties." On the other hand I defy any person to defend the radiating receiver or the rights of any individual to use it.

The other remedy would be "super-powered" transmitters that would make the construction of such delicate and highly efficient receiving sets unnecessary.

No, I did not hear any European Stations.

Cordially,
PERCE B. COLLISON, Brooklyn, N. Y.



ON CUBAN SANDS
The party which installed the station had to live in tents for some time before other buildings could be put up to house them

How Wireless Came to Cuba

The Drama and Struggle of Strenuous Radio Times in the Jungle—Hitherto Unpublished Memoirs of High Technical and Human Interest—What Really Happened in the Early Days of Wireless Telegraphy

By FRANK E. BUTLER

Former Chief Assistant to Dr. Lee De Forest

THE way we went about building a wireless telegraph station in 1905 was an entirely different procedure from that followed to-day when the modern radio engineer starts out to construct a broadcasting or any other type of radio station.

Instead of blue prints to guide us in those pioneer days we used only past "experience," and our stock of that was mighty limited. If past "experience" failed as a means of attaining further satisfactory results, then we relied upon patience and determination. These unscientific assets were all we had to help us in the working out of each new problem.

Up to this time, three high powered stations had been erected by Dr. Lee De Forest, one at the St. Louis World's Fair, one at Pensacola, and the third at Key West, Florida. These stations, while practically of the same design and construction, had presented in their building individual problems which had to be worked out These experiences had somewhat tempered our conceit as to what we thought we knew about installation. We began to realize the uncertainty of any set radio laws, and to expect anything to happen, or fail to happen.

This was the situation when I went to Guantanamo, Cuba, to erect the next in the series of five powerful stations to be built by Dr. De Forest for the United States Navy Department.

I sailed from Key West early in the spring of 1905 for Havana from whence I was to take a train overland to Santiago and from there embark once more by boat to within a few miles of my destination.

A brief stay in the delightful city of Havana

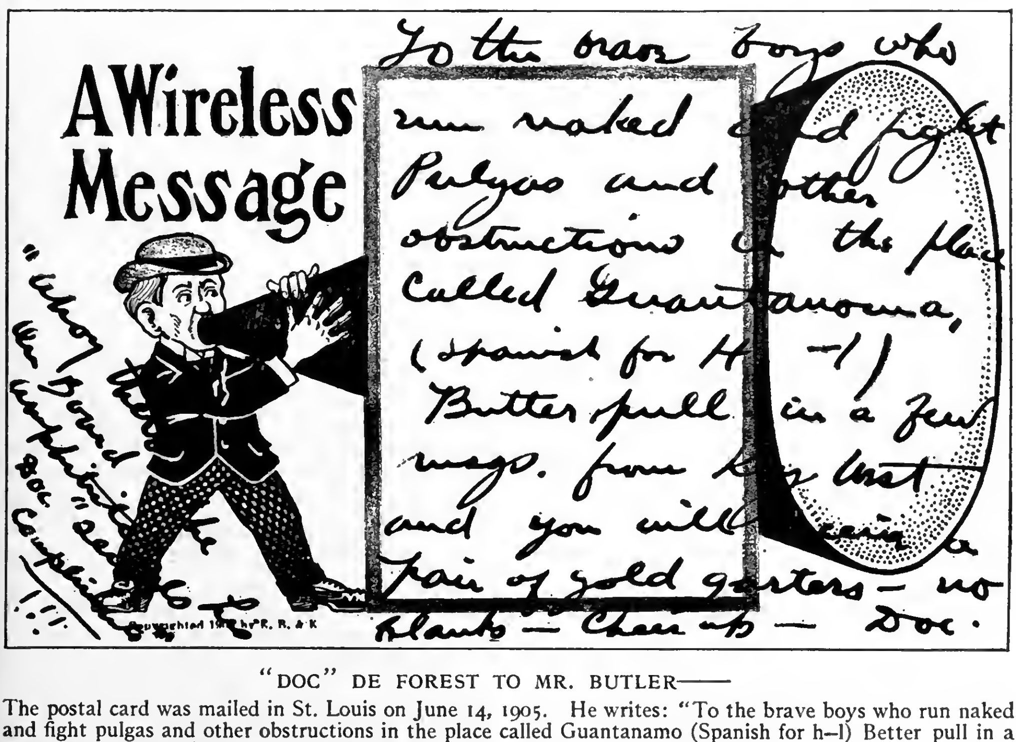
enabled me to form an idea of the difficulties I would have in a country whose language I didn't know and where buying facilities were very inadequate. My stay there was during the celebration of the first Cuban Independence Day, which resembled our own Fourth of July. The city was full of natives from all over the island, and when the train left Havana that evening I was mixed in with the most motley lot of passengers I ever met. I was the only white man.

A great quantity of wire, instruments, etc. had been shipped to me at Havana from New York. Having been forewarned of the advisability of not checking this material as baggage or shipping it via express on account of the unreliability and slowness of these methods, I decided to take it all in the car with me. As a result, my seat in the so-called, "sleeper," resembled a baggage car.

EN ROUTE TO GUANTANAMO

THE train dragged along slowly all night and seemed to stop at every sugar plantation. In the morning we stopped thirty minutes at a town for breakfast which was served in a large room adjoining the depot. The passengers swarmed in there like a lot of cattle. There were no chairs, just long benches to sit on. Everybody grabbed, and so did I. They all talked Spanish, and they all talked at once. I was the only American in the crowd. The only Spanish I knew was "agua" but as they did not have any water, this one-word proficiency in the language was useless. Everybody was drinking wine, so I drank it, too, the while I sat in amaze as I watched the others empty glass after glass until they were stopped only by the call that the train was ready to move on.

At each station I hoped that some one would come aboard who could speak English. But all that I heard from the new passengers as well as the old, was Spanish. During the stop for lunch I was sitting rather disconsolate by myself when I noticed a dapper young Cuban army officer, who had, apparently, been to Havana for the recent celebration. He appeared very popular with the entire crowd. Just before leaving the station to board the



"DOC" DE FOREST TO MR. BUTLER——

The postal card was mailed in St. Louis on June 14, 1905. He writes: "To the brave boys who run naked and fight pulgas and other obstructions in the place called Guantanamo (Spanish for h—l) Better pull in a few msgs. [messages] from Key West and you will receive a pair of gold garters—no blanks—cheer up—Doc." And along the side: "'Ahoy there on board the *Amphitrite*—Doc sends his compliments'" The pulgas are small insects, almost invisible. They swarmed about the station in clouds, and their bite, while not poisonous, was very annoying. Since these insects chose to hover under clothing, the radio pioneers at Guantanamo often took the easiest way and removed most of theirs, hence Dr. De Forest's remark about the "boys who run naked"

train he came over to me and said, in perfect English, "Hello, John. Are you going to Santiago?" Every stranger in Cuba in those days was called, "John."

When I replied in the affirmative, the dashing young officer told me that he, also, was going there. From that moment the aspect of the trip was changed. I had found a companion, and a delightful one he proved to be!

About three o'clock the train stopped at what appeared to be a railway terminal. I stepped out to the platform for a little exercise while engines were being changed. After about ten minutes everything was in readiness, yet the train did not move. Fifteen, twenty, thirty minutes passed, and still we stood there. I noticed a little crowd by the baggage car so I strolled up to investigate the trouble. Imagine my surprise to find the entire crew circled around a large coil of wire which had been taken from my seat while I was away. All were talking excitedly and casting suspicious glances at me. I couldn't understand the situation. I hurried back to the "sleeper" to seek the assistance of my English-speaking Cuban friend. He came forward with me and asked what the trouble was. They explained that it was against the rules of the company to carry such kind of "baggage" in the sleeping car unless the express charges on it were paid. I had visions of a hold-up which would either mean most of my money for carrying charges or the confiscation of my tools and material. So I asked my interpreter to inquire the amount of the charges. The excited gestures and the combined talking of the crew increased my fears and I expected the worst. Imagine my surprise, however, when I was told I would have to pay the railroad company thirteen cents in American money to release the wire so that the train could proceed with my baggage in the sleeper. Upon payment of this sum I had to wait for several receipts and then the train again started on its journey.

We arrived at Santiago about nine o'clock that evening after a twenty six hour drag. It was dark and the town was lighted with old fashioned kerosene street lamps. Through the officer I engaged several Cuban boys to assist me to the dock with my luggage as there were no conveyances about. From here I boarded a small steamer enroute to Boqueron, located on the interior shores of the Bay of Guantanamo.

The boat steamed out of the bay and past old Morro Castle over the spot where, a few years before, Hobson had sunk the *Merrimac*. We skirted the southern shore of the island and could see, as we passed by, the dim outlines of some of the hulls of the Spanish fleet which Admiral Sampson beached during the Spanish war.

THE SCENE OF ACTION

EARLY the next morning we arrived at the little group of huts which was called Boqueron. This hamlet port was the nearest point to the site of the contemplated government wireless station, which in Spanish was called telegrafo sin hilo.

It will be remembered that it was only a few years previous to this time that the Spanish-American war occurred which resulted in the freedom of the Cuban people. The United States Government had only very recently completed the arrangements of the formal turning over of the island to its natives, and it was the jollification at Havana which I saw only a few days before which had been held in honor of the event. In this transaction it was agreed that the United States should retain a small spot in Cuba as a naval base and coaling station. The site selected was the Bay of Guantanamo and its surrounding land consisting approximately of thirty-six square miles. About half of this was land and half water. The entrance from the sea was through a narrow inlet with high hills on either side extending along the coast. It was an ideal land-locked harbor, and big enough to accommodate all the navies of the world at once.

The sight of the harbor was inspiring, and the sight of Boqueron was depressing in proportion. The principal building was at the dock. A few native huts, a store and a saloon, housed the entire population of, perhaps, twenty-five people. The loungers around the dock were a tough looking lot, mostly negroes or half-breed Spaniards, just the kind you see in blood and thunder plays. I learned later that a few of them were fugitives from justice, and two were wanted in the United States for murder.

As I needed assistance to get overland to my destination I engaged a Jamaican negro, George Morehead, who spoke English, to go as my guide. We strapped the luggage across the backs of two horses and started afoot on the hike through the jungle to the government "lines" beyond which was the continuance of the jungle to the point where the wireless station was to be built. Government surveyors were the only white men who had pre-

ceded me through this wilderness, and the marks of their hatchets as they hewed the trail through the underbrush, were the only signs that any one had ever been there before. The land on this entire reservation, and for miles beyond, was in its virgin state. All was a dense undergrowth and jungle, interspersed with low, arid, sand flats: a paradise for mosquitoes, snakes, horned toads, scorpions, tarantulas, wild cats, and all other kinds of tropical creatures, flying and crawling.

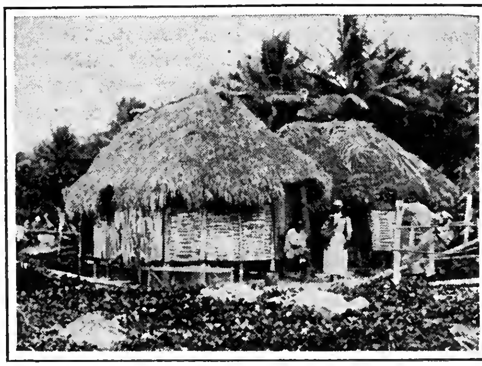
I found George an intelligent fellow, entertaining and thoroughly trustworthy. This in itself was a godsend, as one would hardly expect to find anything like honor in surroundings such as these. As we journeyed he asked me if I had a pistol and I told him I had. He advised me to carry it always in my belt whether or not I ever had occasion to use it, as the many bad Negroes down there behaved only when they knew that the white man had a gun. I later found this advice valuable.

ONE THRILL OF MANY

ONE of my first thrills happened on this pathfinder trip. As we emerged from the jungle trail onto a wide level stretch of sand flats, I noticed that far ahead of us the earth looked bluish white, while beneath us it was hard packed salty sand. Nearing the blue patch I noticed this "land" moving. Slowly the bluish white part was separating in the middle with a wide swath and making a path showing the earth underneath. The negro, noticing my amazement, smiled and told me that this was a large army of land crabs scampering away to avoid us. They were there by the millions—ugly, worthless, destructive creatures with glaring, protruding eyes and wicked claws, some of them as big as human hands. In their cowardly nature they scurried and scampered away from us. But had we fallen helpless by the wayside they would immediately have returned to devour us.

A short time previous to my arrival the U. S. monitor, *Amphitrite*, had anchored in the harbor with officers and men to break ground for the construction of the new Naval Station. This ship was the Naval headquarters of the entire reservation and its commanding officer was the acting Commandant of the Navy Yard. Three Navy electricians from the ship were assigned ashore with me. They were: John Watts, Chief Electrician, of New York, Roscoe Kent of St. Paul, and V. Ford Greaves of Minneapolis.

First we lived in a tent and got our food



A TYPICAL NATIVE HUT

supplies from the ship. The initial general work to be done was the clearing of the dense growth of mango bushes which grew profusely along the shores around the station site. This made sport for the mosquitoes. Next a small dock was made so as to land supplies for the engine house and other necessary material. Finally, the engine house was completed to the extent that we could move in there until our regular living quarters were finished. Mosquitoes by the millions abounded and they made life miserable for us both day and night until we were able to obtain the necessary fine mesh netting to protect our tent and house.

It was not uncommon to be awakened in the night by the sound of a wildcat outside, for the animal was attracted there by the smell of food. Once we failed to close the flap of our tent and were awakened in the middle of the night by a suspicious but familiar sound inside. We switched a flashlight in the direction of the sound. Instantly a huge cat sprang completely across three of our cots to the tent opening and escaped with our next day's quota of meat.

Any one who has ever witnessed a southern sky can understand our enjoyment in watching the southern constellations which are so different from those at home. Huge fireflies as big as bumblebees emitting a bright green light filled the air at night. Small deer were plentiful and once we shot a fine specimen from our door. In the nearby inlets were the beautiful pink plumed flamingo birds so free from the haunts of man as not to fear our approach. In the waters all about us were gold fish, star fish, sea urchins, cow fish, and scores of other tropical wonder fish, besides many of the edible variety.

But enjoyment of the scenery had to take

second place to work. Heavy concrete abutments were constructed for the huge towers. These were in triangle formation three hundred feet apart. The towers were made of eight inch timbers, about three feet square at the base and tapering to one foot square at the top. They were two hundred and eight feet high. Suspended from the cross cables at the top was a big fan antenna from each of the three sides of the triangle. Heavy, seven-strand phosphor bronze wire was used and each triangle consisted of about 15,000 feet of wire or a total of 45,000 feet for the entire cage. This immense amount of wire weighed over a third of a ton, or the equivalent to the amount used to-day by radio fans in building five hundred sets of antennas. The huge cage resembled a giant gold fish globe two hundred feet high, and months afterwards, when the station was in operation, the mesh of wires would emit a bluish brush discharge at night which was beautiful beyond description and always proved of unending awe to the natives who would stand off from afar and gaze in open mouthed wonder.

QUARTERS

THE main building consisted of six rooms, which included living quarters. About 100 feet distant was the engine house which contained a 50-horsepower gasoline driven dynamo that furnished the electrical power. The station was rated at 20 kilowatts. One room contained the operating instruments, another the huge condenser trays, the spark gap and helix. So many wires from the antenna came into the one point of the bottom apex that it was necessary to build a gibbet to hold them on account of their weight before running them into the station.

It so happened that the site of the station was selected by Navy officials who instead of first considering its location from the point of its adaptability for perfect wireless work, selected it because that particular space was down on the blue print as the place, just as every other building planned for the reservation. As a result, a worse location could not have been chosen, The little peninsula upon which the station stood was wholly of coral formation, entirely dead as far as moisture or good ground facilities were concerned. This condition gave us no end of trouble in getting the station to function properly.

The days were hot and dry and the insects bothered us so much that work progressed slowly in the erection of the buildings and the installation of the apparatus. Many times it was necessary to tie a towel around one's face, neck, and head, leaving only opening enough to see and breathe, wearing overalls and shirts saturated in kerosene was another method used to ward off the pestering insects.

Hard luck seemed to follow every move. High winds often blew down our antenna, and the station was struck by lightning three times. Once we experienced a slight earthquake shock, but aside from frightening us it did no damage.

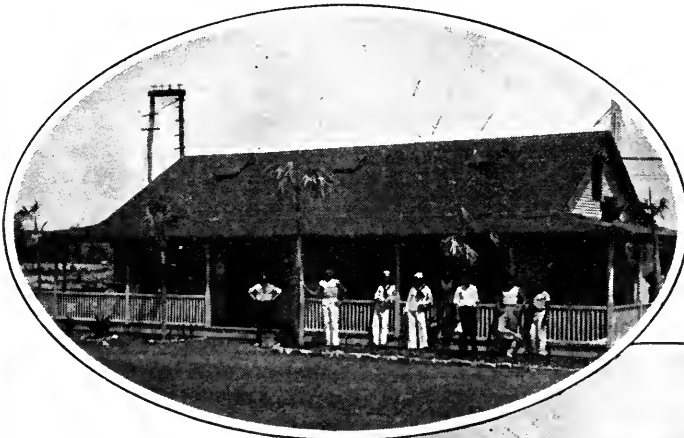
An outcast Frenchman by name of Émile was our cook. He spoke broken English, poor Spanish, and never ceased telling us of his acquaintance with Sarah Bernhardt. He was a chef by courtesy only, but was the best we could procure in that godforsaken land. Another interesting member of our family was Marianna Binega, a Cuban Negro, black as the ace of spades, but loyal to the last degree. He was a general roustabout; but did everything in his power for us. He watched over our health and comfort always, once saving me from the bite of a scorpion by quickly cautioning me not to put my arm in the sleeve of a coat which had been hanging for some time in the closet without being worn. Excitedly he told me in Spanish (which by this time I had begun to grasp) to shake the garment. Sure enough, out from the sleeve dropped the wicked insect which Marianna quickly surrounded with an oiled wick, then lighted it so that the scorpion would commit suicide—which it did—thus giving me, as Marianna had designed—another souvenir, which I still possess. To Marianna, I was, "Mistah Fraang." Kent was "Mistah Kee." Watts was "Mistah Gwaa" and Greaves was "Mistah Greavo." He was as faithful as Friday to us.

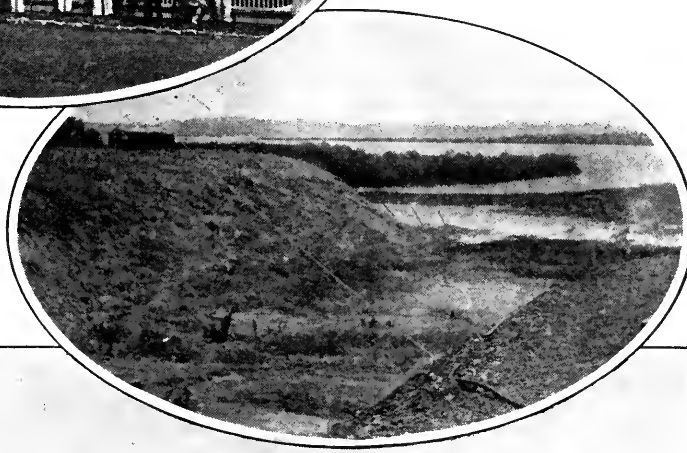
GOVERNMENT INSPECTION

FOR some reason, unknown to me, a so-called government inspector was sent there for the purpose of watching me and my work. I will not mention his name here, but Marianna called him "Mistah Sinka-Walla" and that name stuck with him till he left after I did. He stayed on the job religiously for eleven long months, every day, Sunday included, from 8 A. M. till 5 P. M. He watched me constantly and said nothing. Never a word of encouragement or suggestion, but whenever anything went wrong he was always there with his familiar, "I thought so."

As we had no fresh water supply on account of the dead ground formation, we made a cement cistern to hold our drinking water.

To obtain this water it was necessary for the Government tug to steam up the Guantanamo River to where the supply was fresh, there fill its tanks, and then run down to our dock and fill the cistern. Usually it required half a day to do this and of course was of some expense to the Government, so naturally we tried to be as saving with the water as possible. One day after this filling was done, we forgot to place the cover over the cistern hole and that night a big wildcat, smelling the fresh water, went to the opening, fell overboard, and was drowned. The next morning Mr. Watts notified the officer on the ship of what had occurred, and requested that the water

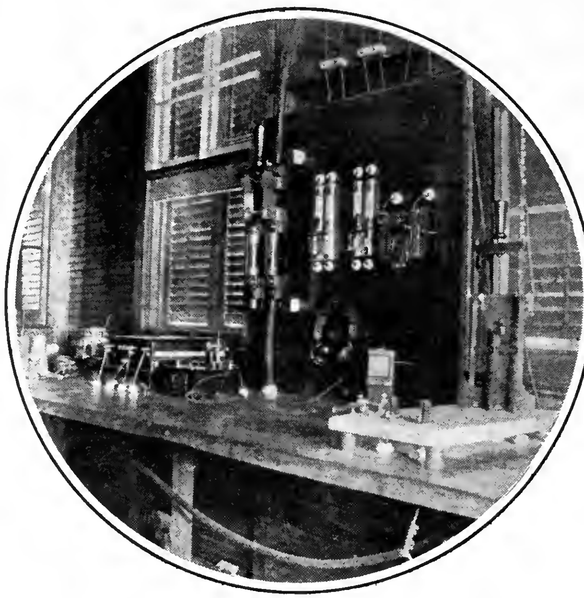




IN AND AROUND THE WIRELESS STATION

Which was installed by Mr. Butler, working for Dr. De Forest's American Wireless Telegraph Company at Guantanamo, Cuba, for the United States Navy. The lower photograph shows the station house and the masts. The oval next above it shows the view of the Cuban landscape, on which the operators could feast their eyes. The top oval is taken outside the operating shack and shows a part of the staff then attached to the station

be pumped out and the cistern refilled with fresh water. A prompt, curt refusal was the result. Such an order coming from their superior officer had to be obeyed, of course. I then sent a similar request and received the answer that the matter had been taken care of through Mr. Watts. Here, then, was the first time it was necessary for me to use the special letter I had from the Secretary of the Navy which requested all officials where I operated to assist me in every possible way. Without further argument I cabled Washington. Within a few hours an answer came and we got what we asked for. A short time afterwards a case of yellow fever broke out in the laboring camps near by and my three Navy companions were ordered to vacate the station and come aboard ship until the disease subsided. This inhuman action left me helpless and alone at the station with an imminent danger near. I again sought recourse from the Navy department with instant and satisfactory results.



THE OPERATING ROOM AT GUANTANAMO

The huge contrivance on the right is the antenna switch; next is the power-control panel. An electrolytic detector and slide tuning coil receiver completed the installation

In reviewing my old diary I find under date of Tuesday, November 14th, 1905, that I employed a Negro by name of Joe Francis to repair a parted main antenna cable which spanned the space of 300 feet between two masts. To repair this was not only a difficult task but an extremely dangerous one because most of the splicing work had to be done 200 feet above the ground. No one but Francis could be found who was daredevil enough to risk it. He was a notorious bad man and had a price on his head for a murder alleged to have been committed in the United States. I dickered with him to do the job for $40.00 and he accepted.

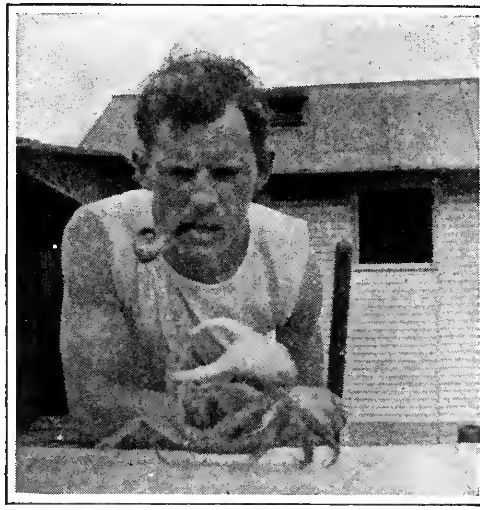
However, after he had nearly finished the work, and while sitting up there swaying between heaven and earth, he called down and declined to proceed unless I doubled the amount of pay. This I flatly refused to do and he still maintained his strike until I drew my pistol and threatened to shoot him down from his perch unless he completed the job as he had contracted to do. To this threat he promptly replied: "I guess you'd do that all right, Mistah Frank. I'll finish the job." I kept him covered while he continued the work because he continually looked down at me to see if I still meant business. He afterwards told others he was going to get me for that trick.

One night about nine o'clock, a few days later, one of the station boys and myself were returning with fruit from "the halfway house," a tent shack, not far away where native fruits and vegetables could be bought.

The night was starlit and the journey was three miles over a zigzag path through the jungle. We had to walk single file. Some of the spots on the way were so dense with overhanging moss and tropical foliage as to entirely cut out the view of the sky. There were comparatively few snakes here, but there were plenty of horned toads, tarantulas, land crabs, mosquitoes, and wildcats, so we always carried a pistol. At a spot, such as this, one third of the way home we met Joe Francis, the Negro. He spoke coolly and slunk by us like a panther, looking over his shoulder as he passed. Fortunately I was ahead of my partner and I think this was what saved me. We were suspicious of his designs, so the instant he left our view we turned off the trail and penetrated the jungle, deciding to attempt to feel our way home through the unchartered underbrush. This, in itself was dangerous, but we thought it the lesser of the two evils. Scarcely had we left the path and fallen to the ground than we heard Francis retracing his steps stealthily. Not having

a compass with us we selected, before moving, a group of stars which we figured was above the wireless station. Then, instead of starting directly for the station we doubled back further toward the way we had come and planned on a wide circle around so as to enter the station from the other side, thus avoiding that trail entirely. We encountered bogs, marshes and everything imaginable, but after several hours of maneuvering we reached home safely and without further adventure.

About a week later, Castro Frerrar, a Spanish surveyor with whom I was well acquainted, was stabbed and killed on this lonely trail a short distance from the wireless station. No one ever knew who did the deed or for what purpose. He was about the same size as I and might easily have been mistaken for me. The singular coincidence was that Joe Francis left a few days later and was never seen or heard of afterward.



A LAND CRAB

Which was caught in the act of carrying away a pair of overalls belonging to one of the workmen at the station. His claws are about the size of a man's hand. These bluish white molluscs crawling across the bare wooden floor of the porch at night sounded like people walking across the creaking spaces

TESTING THE STATION

FINALLY after many months the station was completed and the long series of tests began. Static was terrific. It was a continual rumble. Our principal tuning device was a two-coil slider which to-day would not be considered worth anything by a nine-year-old school boy with a crystal set. Realizing the immense importance of developing the receiving end of wireless, Dr. De Forest left Key West and went back to New York to study out this problem.

I firmly believe it was our gruelling experience with these southern stations that turned the doctor's attention so strongly toward this subject that he never gave it up until he later perfected the heart of radio—his three-element audion bulb, without which present day broadcasting and receiving would be impossible.

His immediate work, however, after going north was to perfect a tuning device which would handle static better. This led to his invention of the pancake tuner which consisted of fine insulated wire wound spirally on glass with variable adjustments. This we found more efficient than anything used previously and it became one of the principal elements in the success of these installations.

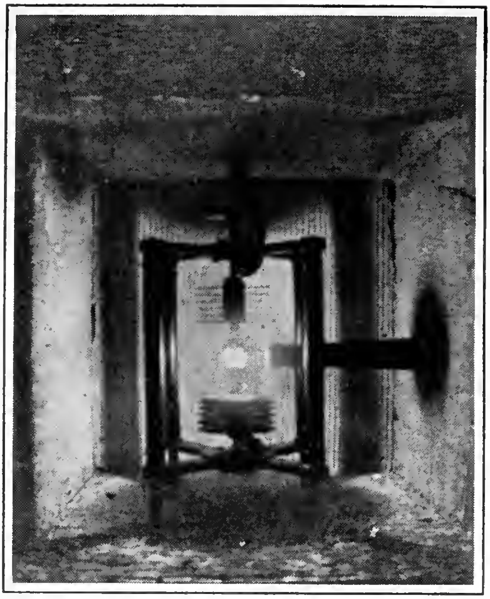
In reviewing the many letters which passed between Dr. De Forest and me during these trying days it is gratifying and interesting to note his keen appreciation of our difficult work—his determination to succeed, and his constant belief in ultimate success. Too much credit cannot be given to Dr. De Forest for what he has contributed toward the development of wireless and radio. His dominant persistence, patience and ability were as prominent two score years ago as they are to-day. Had this developement been left in the hands of a less determined or less capable man than he, it would probably not be in the advanced stage it is to-day. I firmly believe this, because during the twenty years I have watched the progress of radio I have seen many experimenters who started with great expectations but soon fell by the wayside, not strong enough at heart or in ability to stand the test of constant disappointments.

Here are a few excerpts from some of the De Forest letters:

July 28th, 1905: Your very interesting letter concerning the lightning storm received. It was a very graphic account of a frightful experience. I appreciate your devotion to the cause in taking the risk you did and am glad so little damage to our apparatus occurred.

August 9th, 1905: You certainly are the star martyr to the wireless cause at present and have our fullest sympathies—if those will do you any appreciable good. None of us are too happy or enjoying flowery beds of ease. It is a tough problem and I can't tell what "ist los," but will keep on trying new stunts until it is solved. "Never say die," and "You can't stop a Yank," are the two cardinal mottoes of the wireless bunch, you know.

October 4th, 1905: "I am enclosing plan for



THE SPARK-GAP AT GUANTANAMO
The electrodes were encased in an asbestos-lined muffler box. The spark jumped a one-inch gap, shunted by four large condensers

connecting up the six condensers. The tinfoil has been shipped from the lab. You can put this on with paraffin, as we generally do now, *building up the whole thing under oil.* (Imagine working for days with arms immersed in kerosene.)

November 8th, 1905: Glad to get your long letter of 30th, and regret it is so full of hard luck tales. Sincerely hope your big transformer (weighing a ton) won't blow up again and believe that the new ground plate will remedy your troubles. You show splendid grit as you always do in facing these difficulties.

November 20th, 1905: Your yellow feverish, earth quakish letter came to hand this morning. I am sorry your troubles are holding up so well, but do not get discouraged as we have ours here, and you have not succeeded in cornering the trouble market by any means.

December 26, 1905. I want to thank you most heartily for the very kind letter of Christmas greetings you wrote me. There is no one in our employ who has shown himself more loyal and determined in his efforts to hasten success of the system than yourself, and you may be sure that I appreciate it fully.

Then, in reviewing my diary of that year, the following few terse sentences graphically portray the unbroken schedule of daily mishaps we encountered:

June 5th, 1905: Big 50 H. P. motor generator blew up, damaging armature.

June 7th. Commenced taking off tin roof on building and substituting it with asbestos.

June 12th. Commenced repairing damaged trays in condensers.

June 14th. Lined condenser trays with portland cement.

June 26th. Killed an 8-foot Moha snake in back yard. This was the cause of so many of our chickens disappearing.

July 10th. Constructed plate glass condensers for motor and circuit breakers.

July 13th. Terrific storm 2:30 A. M. Lightning struck station bursting an entire room full of condensers—just finished after two weeks of hard work—throwing oil and plate glass all over the room and into the walls.

July 14th. Repaired damaged antenna wires.

July 26th. Changed all d. c. wiring throughout station 36 inches away from a. c. from engine house to station.

August 14th. Rained this evening during exceedingly bright moon which caused unusual phenomena of two bright rainbows at night.

August 21st. Small cyclone struck us.

August 31st. Lightning struck the station at 4:15 P. M. blowing up one set of condensers.

September 5th. No fresh water. Had to drink salt water all day.

Sept. 24th. Another entire span of 15,000 feet antenna wire blew down.

Sept. 27th. Touched off station again and blower motor blew up.

October 8th. Herd of horses from workmen's camp broke corral in night and demolished the guy wires on the entire aerial spans twisting wires badly.

October 15th. Earthquake at 4:43 P. M. while eating supper.

October 17th. Finished new ground to-day.

October 19th. Rewound blower armature.

November 7th. Secretary of Navy Taft visited us to-day.

November 17th. Heard Key West and Pensacola first time.

December 10th. Key West heard us first time. Blew up blower motor.

December 15th. Big two-ton transformer blew up.

I had almost begun to think I was waging a hopeless battle against nature as week after week a fresh burst of some new and unforeseen trouble presented itself.

MORE TROUBLE

ABOVE the door of our station we tacked a motto: "Abandon hope, all ye who enter here, for verily this *is* hell." It was there for months and was a grim way we had of joking with ourselves.

It was not until the following March that we finally overcame all our troubles and succeeded in establishing communication with

our distant stations to the entire satisfaction of the Navy Department.

When the end finally came, when my work was finished, I was more than overjoyed to get away from that place of trials, but I was sorrowful to leave my three faithful navy companions, Watts, Kent, and Greaves, likewise faithful Marianna, who so loyally stood by me through, perhaps, the most crucial period that any group of early wireless workers ever experienced.

In the meantime, Dr. De Forest had sailed for Europe and shortly after my arrival in New York I received the following letter from him, which I highly prize, because of the wonderful sentiment and appreciation it discloses.

London, E. C.
April 20th, 1906

Mr. Frank E. Butler,
New York City.

My dear Frank:

Upon the occasion of the final acceptance by the U. S. Navy of the five large stations, of which you have been in charge, I wish to extend to you on behalf of myself and of the American De Forest Wireless Telegraph Co., congratulations, hearty and sincere, and to felicitate you upon your safe return to God's country.

Too often it is the case that while the faults and blunders of men receive prompt and severe criticism, the merits of their work, the fidelity of their services pass unacknowledged, even if fully appreciated by their employers. I trust that this may never be the policy of our company.

All of the officials of this corporation have watched with intense pride the heroic efforts you have made, the great patience through long months of discouragement and difficulties which have necessarily preceded this success. I can deeply appreciate the nature of your labors, your trials, the hardships you have undergone, for it has been my good fortune to have been with you at your post and shared in, while directing, your work.

This work, these experiments, these long-drawn-out tests, carried on in the face of unforeseen and manifold difficulties have, I believe, not only achieved the wireless success intended, but have been the means of developing character, a determination to bear and achieve like good soldiers; have ripened a friendship and a loyalty to one another and to a worthy cause, which constitutes in life elements of even greater value than commercial success.

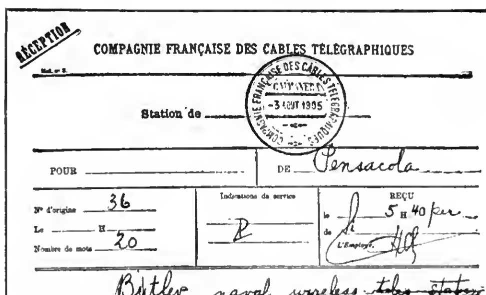
We do not, we cannot forget the obstacles you have had to face and which you have bravely overcome.

For tedious months away from home and friends, in climates scorching and unhealthy, deprived of all usual comforts of life, tormented night and day by insect pests, distressed but not baffled by static unkown to any other wireless workers, delayed month after month by breakdowns of Navy apparatus, continually called upon to make repairs, often without proper tools, facing skeptical criticism, surrounded by hostility, open or concealed on the part of officials from whom we had every reason to expect coöperation and interest,—yet, you have stuck to your posts, have triumphed over one difficulty after another, have forced new secrets from Nature, and having by your tenacity, patience and skill accomplished your ends, you have won at last an acknowledgment of the success of the system from the entire Navy Department, and set a new standard in the art of Wireless Telegraphy.

In view of your services in this unexampled undertaking we wish to express, although in inadequate words, some portion of praise you so well deserve, and to express our confidence that this navy work is but the beginning of greater things we are yet to accomplish together in wireless.

Very sincerely yours,
Lee De Forest.
Vice Pres. and Scientific Director.

All the desperate trials of the Cuban experience seemed wiped out by this letter. For were they not worth it, those trials, when one was working for Dr. Lee De Forest?


RÉCEPTION
COMPAGNIE FRANÇAISE DES CABLES TÉLÉGRAPHIQUES
-3 AOUT 1905
Station de
POUR
DE Pensacola
Nº d'origine 36
Nombre de mots 20
Indications de service
REÇU 5 H 40
Butler naval wireless telg station
Guantanamo
listen five thirty to eleven thirty am
no night work check coming
Lee deforest

ONE OF DR. DE FOREST'S CABLEGRAMS

To Mr. Butler and his associates in Cuba. It was filed in Pensacola, Florida on August 3, 1905 and reads: "Butler Naval Wireless Station Guantanamo listen five thirty to eleven thirty A. M. no night work check coming Lee De Forest". Many messages of this sort had to be exchanged before the new Naval station in Cuba could be put in order

The Factors Governing Radio Receiving

Why Daytime Reception Is Less Than That at Night—Why Signals Fade—How Selective Should a Receiver Be?

WHAT MAKES THE WHEELS GO 'ROUND: XI

By WALTER VAN B. ROBERTS

THIS installment of Mr. Roberts's series of explanatory technical articles answers some of the questions most often asked by the broadcast listener. Many attempts have been made to explain the phenomenon of fading in radio, and still, although radio is more than twenty-five years old, we know but little definitely about it. Here the best-known facts have been gathered together, and every reader whose set has come to mean more to him than a box containing tubes and wires will be interested to read what an authority has written on the subject of radio reception. The next and last article in this series will appear soon. It deals with the operation and use of the various accessories of the radio receiver.—THE EDITOR.

THERE are three main factors governing the distance that can be satisfactorily covered between a given transmitting station and a given receiving set.

(1) The amount of interference.

(2) The inverse distance effect. As the radio waves spread out in all directions from the transmittng station their strength naturally decreases. At twice the distance their amplitude is halved, at four times the distance it is only one quarter, etc.

(3) The attenuation, which is quite a different thing. It acts simultaneously with the inverse distance effect to reduce the amplitude of the waves. Attenuation of the waves is due to their being dissipated in the form of heat. Whenever the waves strike any object in which they can produce electric currents, the currents are produced at the expense of the energy of the waves and heat up, to a minute degree, the material in which they flow. The result of this is that, independently of the inverse distance effect, every so many miles the strength is reduced by a certain fraction of what it was at the beginning of those miles.

Thus if the amplitude is cut down by attenuation to one half of its original value at the end of the first hundred miles, it would be only one fourth after two hundred miles, one eighth after three hundred miles, one sixteenth after four hundred, etc. This is the same sort of thing as the compound interest law, and mounts up very rapidly. In the case of ordinary telephony over land wires, the attenuation is such that the current is about one third, at the end of every ten miles, of what it was at the beginning of those ten miles, and a little calculation shows that to talk across the continent without any amplifiers inserted along the line would require more power than is available in the whole world—in fact more power than the sun gives out. Yet by the insertion of a dozen or so amplifiers or relay stations along the line, the attenuation law is prevented from "getting well under way" and a ridiculously small power is enough for transcontinental telephony.

In daytime, the attenuation of radio waves (which is possibly due to the air being rendered slightly conducting by sunlight) seems to be fairly constant and reliable. At night, however, it may be anything between the daytime value and nothing at all. On especially good nights in winter when there is practically no attenuation, stations can be heard at great distances because the spreading out effect is all that is at work to weaken the signals. Thus, for example, a station that can be heard fifty miles in daytime could be equally well

heard, on one of these good nights, a thousand miles away by simply adding a stage of radio-frequency amplification which would amplify the received signal twenty times before supplying it to the detector.

The mere absence of attenuation is probably enough to account for the numerous cases of the simplest sort of receiving equipment sometimes hearing stations thousands of miles away, while the presence of the daytime attenuation accounts for these same sets failing to get equally powerful stations only a hundred miles or so away in daytime.

82. FADING

IN THE close vicinity of a transmitting station the inverse distance effect is the main factor in weakening the signals. Hence near-by stations come in about as well by day as by night. Above a few hundred miles the attenuation is the chief factor, but there is also another type of variation of signal strength called "fading." Every broadcast listener has noticed this, but many of them think it is due to improper tuning of their receivers. The phenomenon is as follows: suppose a distant station has been tuned-in and we are sitting listening to a speech. Suddenly we realize that the voice is rapidly becoming fainter and in the course of a few seconds it may drop out of hearing entirely. If now we do not touch the receiving set but wait a few seconds or perhaps half a minute, the voice will probably reappear and rapidly regain its original volume. If this happens often, it makes the reception very unsatisfactory. There is no proved explanation of it. Variations in the attenuation constant due to ionization of the air by "storms" of electrons shot out from the sun or interference effects due to some of the waves going from transmitter to receiver via a different path are two of a number of possible causes. The phenomena are so irregular that no law has been discovered governing them.

83. IDEAL SELECTIVITY AND SENSITIVITY OF A RECEIVING SET

THE ideal radio receiver will be as selective as is possible; that is, it will receive a channel of frequencies about 10,000 cycles wide (or only 5000 cycles in the case of single side band transmission) equally well, but will not receive other frequencies at all. In this manner, the door is shut to all interfering wavelengths except those lying in the channel that we must receive. This is all that selectivity can do to reduce interference. (It is assumed that a loop or the most "directional" possible antenna is used to further reduce interference by responding less to interference coming, on the average, from all directions than to the signal which comes from the most favorable direction). The ideal receiver will not need to be any more sensitive than enough to bring in interfering noises with more than tolerable loudness under conditions of *least* interference. When interference is worse, the sensitivity should be cut down to keep these noises from becoming objectionably loud. In summer time the interfering radio waves manufactured by nature are the worst, and rarely stop.

84. MORE POWER NEEDED AT THE TRANSMITTER

AS THIS ideal in radio receivers is not attainable at the present time, there is only one way left to reduce interference with the present wavelengths and improve the distance over which satisfactory broadcasting is possible. That is to have the transmitting stations put out more power and still more power. If every broadcasting station put ten kilowatts into the ether for every one that they are radiating now, interference between stations would *not* increase and the "static" and other noises would be drowned out and the signal would be so powerful that receiving sets could be less sensitive and thus save much more money than would be required to increase the power of the transmitting station. However, just as in the case of land wire telephony we will probably never be able to put enough power into the ether to give good transmission across the continent in spite of bad interference with the daytime attenuation at work. We will more likely send the voice across country by land line to be shot out by radio from numerous broadcast stations so located that everybody will be somewhere near one of them. This system has the advantage that if something that is to be transmitted is of interest to only certain sections of the country, it can be broadcast only from stations in those sections, and thus not cause unnecessary interference in other sections.

"NOW, I HAVE FOUND. . ."

A Department Where Readers Can Exchange Ideas and Suggestions of Value to the Radio Constructor and Operator

FOR a long time, RADIO BROADCAST has felt the need of an outlet for the many excellent ideas dealing with various features of radio construction which reach our office. With this issue, we begin the department of good ideas from our readers, and invite the coöperation of all those who are interested.

If you have an idea about a valuable and useful new circuit, some new device, a construction or operating suggestion, we should like to have it. Payment of from two to ten dollars will be made for every idea accepted. The descriptions should be limited to three hundred words and typewritten. Accompanying sketches, drawings, and circuit diagrams should be as plain as possible.

We do not want simple, obvious suggestions. Material to be acceptable for this department must offer something of definite value to the constructor. Mere novelty is not desired. Address your manuscripts to this department, RADIO BROADCAST, Garden City, New York.—THE EDITOR.

AN ECONOMICAL B.C.L. ANTENNA MAST

MANY and varied have been the articles concerning the kind of apparatus to be used by the radio experimenter, while the descriptions of good auxiliary apparatus have been few. The writer believes that there is a definite need for the description of a mast especially suitable for the broadcast listener.

In designing this mast, the location and needs of the listener have been kept in mind. Simplicity of construction, neat appearance, stability, and ease of erection have been the prime considerations. Due to the number of good well distributed broadcast plants and the increase in sensitivity of the present-day receivers, great height is not required in a mast. Besides, many listeners live in the cities, near the big stations, and where apartments are the dwellings of the majority, so that there is a corresponding lack of room and facilities for the erection of any very high mast.

The mast described below is easy to make, easy to erect, mechanically strong, neat appearing (thus eliminating the objection of many property owners), and best of all it is inexpensive.

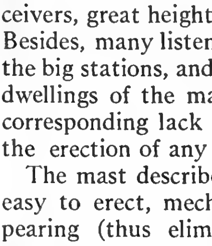


FIG. 2

MATERIALS AND ESTIMATED COST:

Two pcs. 2″ x 1″ clear surface pine, 16 to 24 ft. long	$1.00
One pc 1″ x 1″ clear surface pine, 5 ft. long	.20
Eight $\frac{3}{16}$″ diam. ordinary stove bolts, $2\frac{1}{4}$″ long	.20
Twelve large screw eyes	.20
Pint can outside white paint	.75
Guy wire (length to be calculated)	.50
TOTAL	$2.85

In addition, several screws or nails, usually found in the home work box, and a pair of blocks or stakes will be required.

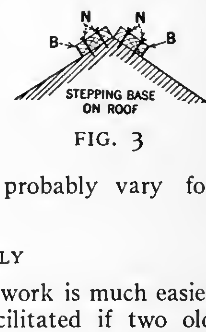


FIG. 3

This total is only approximate and will probably vary for different localities.

ASSEMBLY

CONSTRUCTIONAL work is much easier and very much facilitated if two old boxes are set up to hold the mast pieces while working.

Place the two mast pieces side by side, flat side (the 2″ face) up. Then, starting a few inches from the end, mark drilling points every two feet, stopping at point C, which is five feet from the proposed lower end of the mast. The number of these drilling points will vary as some can get 24-ft. pieces, while others can only get 16-ft. pieces. Drill these holes so they will just take the $\frac{3}{16}$″ bolts snugly. Bolt the two mast pieces together, tighten nuts, and place the mast so the two one-inch faces are now up (bolts parallel to ground). See Fig. 7.

Now cut a one-foot length from the 1″ x 1″ and slip it in at a point a few inches from end of the unbolted portion of the mast (H in diagram). Fasten this in permanently with screws. Cut three more sections (J, K, L) and insert in the same way. Be sure to cut the

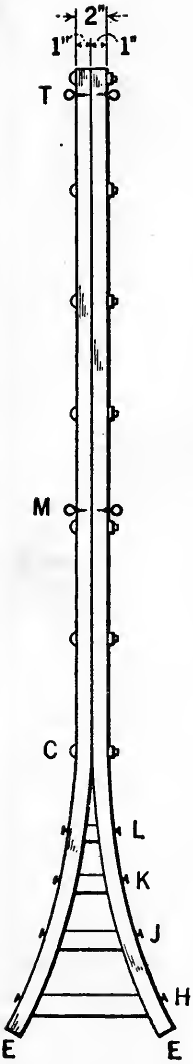


FIG. I

ends of these at a slight angle so they will fit snugly into the slight curve in the wood. A mitre box is very useful if available. Ends E, E are to be sawed off at the proper angle to rest on roof or ground, Insert eyes at top (T) and at midpoint (M), so that two guys will pull backward and one forward (see sketch). Note that the forward eye is not to be put in the crack, but screwed in at an angle. The mast is now ready for painting, which is easily done on the double box rest mentioned previously. Apply *two* coats (one is insufficient and will wear off quickly), giving each a full twenty-four hours to dry, and applying the first thinly. See Figs. 2-5 and 6.

GUYS

IN THE small diagram, P represents perpendicular pole height, and B the distance from base to point at which you will anchor the guy, of length L. Square P, square B, add these together and take the square root. The result is the guy length L. Three are needed at the top and three more that are attached at M. Be sure that P for the latter is measured from base up. Add at least a foot to each of the guy lengths to allow for twist when securing to pole and at the base. See Fig. 7.

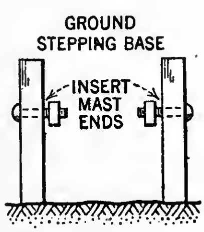


FIG. 4

STEPPING THE MAST

IF THE mast is to be on the roof, a stepping base should be built. This consists of two blocks of wood nailed to roof as an inverted V at point of rest (see sketch.) The mast is stepped against this in raising so that one man can raise it alone, as he would a long ladder. Tying in a couple of guys in advance assists materially. Block and tackle attached to a near-by tree or building may be used if available. This is shown in Fig. 3.

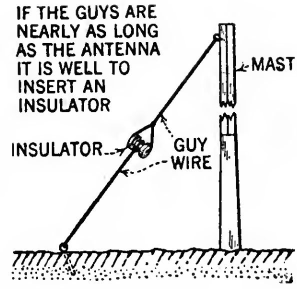


FIG. 5

If the mast is to be raised from the ground, two stakes may be driven in and ends of mast bolted to these as swivel points in raising. See Fig. 4.

ANTENNA

THIS mast will easily support an antenna of several wires with their spreaders. However, for most reception, one wire is sufficient. Furthermore, attaching a single wire to the mast permanently is highly recommended, as trouble due to broken pulley ropes is thus entirely avoided.—CARLOS S. MUNDT, San Francisco, Calif.

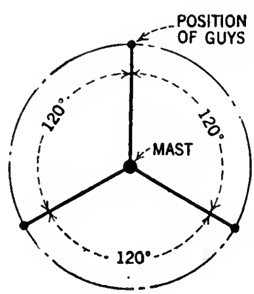


FIG. 6

A HANDY RADIO B BATTERY WHICH USES FLASHLIGHT CELLS

THE block type B battery is not always the best investment according to the opinion of some radio users because when one or two cells go dead the entire block has to be thrown away and its usefulness is gone. If separate cells are utilized however, only the "dead" ones need be discarded. New ones may be inserted in their places and the battery will be as good as ever for considerable continued use. Assembling these, in the ordinary case, is more or less troublesome however when the various connections have to be soldered together. Consequently, the idea described here will be found of great advantage and by its

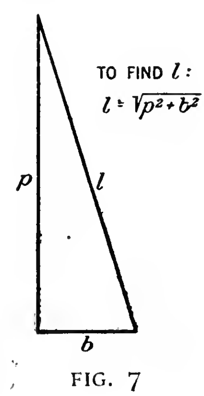


FIG. 7

use dead cells may be instantly removed and fresh ones inserted.

This article describes a $22\frac{1}{2}$-volt outfit using flat flashlight cells of standard size with an e.m.f. of 3.8 volts each. Batteries of higher voltages may be computed from these measurements.

The constructional details are shown in Fig. 8.

Make a box of thin wood whose inside measurements are $4\frac{7}{8}$ inches long, 3 inches high and $2\frac{1}{2}$ inches wide. Shellac the inside to keep out moisture. Remove any projecting nails or metal that might cause a short circuit between two or more neighboring cells.

Next make five contact strips of sheet brass as shown in the little detail sketch. These must be at least $\frac{3}{4}$ inches wide and long enough to bend over and clinch on each side of the wood. Place the six cells in the box and note where their tabs come along the edge. Mark the spots and then remove the cells and fit three contact strips along one side in proper relation and two on the other side of box. Replace the cells, being careful to alternate the relation of the various tabs. The short or positive tab of one cell must be on the same side as the negative or long tab of its neighbor and so on. Thus the strips will connect, electrically negative to positive all through the six cells and build up the resultant voltage to about $22\frac{1}{2}$. As will be noted, the tabs originally bend inward but should be sprung out sufficiently to bear well against the contact strips when the cells are in position in the box.

To prevent the cells from rising from the box due to the springiness of the tabs, it will be necessary to make a top strip of thin wood which must be fastened across the box lengthways. This holds the cells down and makes contacts sure.

A spring clip on each B battery wire enables one to tap in anywhere and secure any plate voltage desired. Such a battery will be found very handy and a considerable money saver.

To insure a positive contact at all times it is well to brighten the contact strips by rubbing with fine sandpaper.—L. B. Robbins, Harwich, Mass.

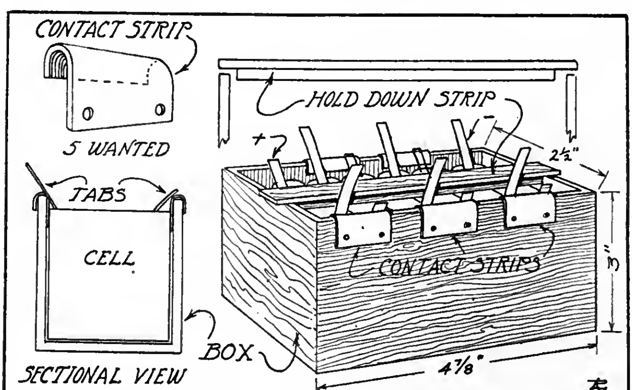


FIG. 8

UN-BLOOPING BLOOPERS

LIVES there a man with soul so dead that he *wishes* to annoy the neighbors by running a blooper?

If so, the neighbors would be justified in making his body match his soul, and the whole town would rejoice, and the minister should refuse to bury him.

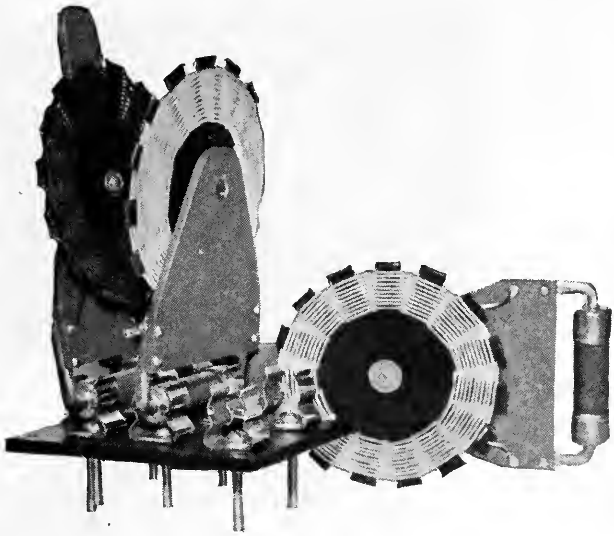
If you own a blooper and wish to avoid such a well deserved fate, and also wish to avoid the expense of a new panel and cabinet you can change it to a Roberts set, (which does not radiate), by mounting three of the spider web coils on the outside of the old cabinet. These are the coils NP, S2, and T, and unless you have a very good set with as many as three tubes it will also give you better reception.

This is not a fashionable arrangement as radio fashions go, but it works quite as well as with the knob-controlled coils, the only requirement being that there must be room in the old cabinet for two .0005-mfd. variable condensers with about four inches clearance between them.

The coil mounting consists of three cartridge fuses two inches long and six fuse clips to hold them. The clips are fastened to the bakelite shown in sketch by $\frac{8}{32}$ brass machine screws $1\frac{1}{4}$ inches long which project into the cabinet for the connections.

The fuse cartridges are drilled out for a $\frac{3}{16}$ inch hole at the ends and the fuses and filling shaken out. Three pieces of $\frac{1}{8}$ inch fibre are cut out as shown in Fig. 9 for the coil controls. These pieces and also the fuse cartridges should be boiled in paraffin for ten minutes to prevent them from absorbing moisture.

The brass rod should be softened by heating to a dull red and cooling in water, cut into pieces $1\frac{5}{8}$ inches long, bent in a vise with a hammer, $\frac{1}{2}$ inch from one end to shape a right angle. The other end should be flattened slightly to fit against the fibre and to drill easier. No. 14



HOME MADE
A simple and very efficient mounting for the Roberts circuit

brass escutcheon pins are used for rivets in the No. 44 holes to fasten the bent rods to the fibre, with heads on the fibre side.

The construction of the coil forms has already been described in RADIO BROADCAST.

The leads of the coils are soldered to the rivet heads or rods. The tickler coil is on the right, coil S2 in the middle clips and coil NP at the left. The third terminal from the coil NP is soldered to a $\frac{6}{32}$ screw in the No. 27 hole in the fibre. Two inches of pig tail wire are soldered to the other end of this screw, a piece of shoestring is slipped over the pig tail for insulation and the free end connects to a small binding post in the hole X.

The coils A and S1 should be mounted on top of the left hand condenser in a horizontal position, using a bracket made of a strip of stiff brass bent at right angles. The three-coil mounting is located on the right hand end of the cabinet with the centers of the coils at the same height from the base board as the average height of A and S1. This may necessitate lowering the left hand condenser, but it is very important to prevent magnetic feedback. Only the right hand condenser which tunes S2 need have a vernier.

The small neutralizing condenser shown in the photograph is very easy to make, the plates being insulated from each other by a piece of thin celluloid or mica. The screw head is soldered to the movable plate and is turned by a piece of hacksaw blade tied in the split end of a stick which allows adjustment from a distance, as this condenser is easily effected by body capacity. For this reason it should be placed at the back of the cabinet, high enough to adjust easily. A screw driver with a wooden handle will also serve to vary the capacity by inserting the blade in the screw head. Once this adjustment is made, for the tube used, it does not have to be altered.
—HARDING GOW, East Sound, Wash.

NOTES ON THE ROBERTS CIRCUIT

IN BUILDING a receiver employing the Roberts circuit I have come across the following points which may be of help and interest to others who build a receiver of this type.

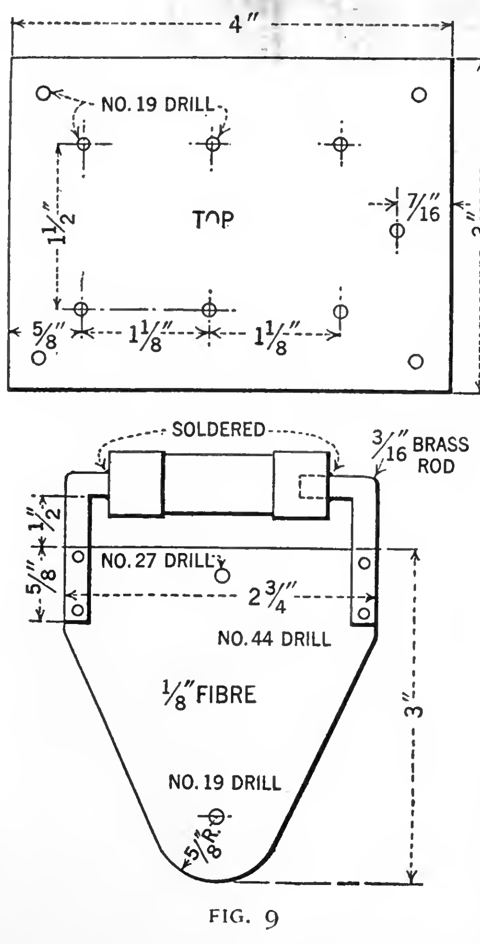


FIG. 9

If the components of the circuit are so arranged that the capacity of the first tube is more than neutralized due to capacity between parts of the circuit, it is impossible to balance

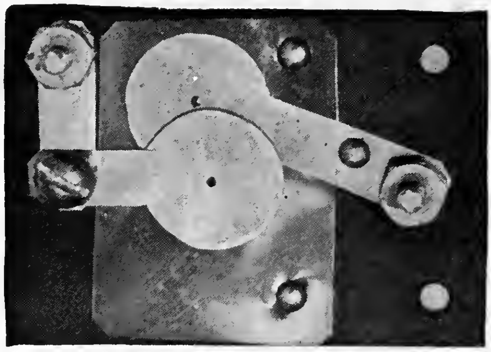
THE ANTENNA COUPLER

By means of a bolt and nuts the coupling between primary and secondary may be varied

the first tube capacity in the usual way. In order to avoid this condition, it is necessary to minimize any capacity between the grid circuits of the two tubes by the following precautions:

1. Mount the two variable condensers so that there is at least a 2-inch clearance between them.
2. Do not mount the audio transformer near the grid circuit of the detector tube.

If it seems impossible to neutralize the tube capacity in the usual way, the neutralizing condenser may be connected as shown in Fig. 10, and a balance obtained by adjustment in the usual manner. To arrange the neutralizing condenser for this connection, solder a



A GOOD NEUTRALIZING CONDENSER

For the Roberts circuit which can be made in the home laboratory

piece of wire, preferably braided, to the neutralizing condenser sleeve and connect this to the grid. Connect the two electrodes of the condenser as in Fig. 10. One to the end of the balancing winding and one to the plate of the tube.

Moving the sleeve towards A balances out the tube capacity as usual. Moving the sleeve towards B increases the capacity between grid and plate of the tube so that if, due to stray capacity as explained above, the tube capacity is neutralized, a balance can be obtained.

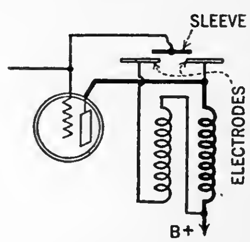


FIG. 10

I have found that a vernier is unnecessary for tuning the circuit of the first tube, but the tuning of the detector tube circuit requires that a vernier be used.

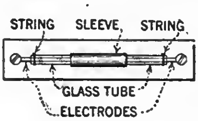


FIG. 11

Some means should be employed to prevent the neutralizing condenser sleeve from coming in contact with the condenser electrodes. A piece of string tied tightly around the glass tube at each end as in Fig. 11 will prevent the sleeve from touching the electrodes while adjustments are being made. —

JOHN B. CLOTHIER, JR., Landsowne, Pa.

Improving the Storage Battery for Radio

By JAMES M. SKINNER

WE HAVE heard and read much concerning the recent developments in various systems of current production from the regular lamp socket as a means of doing away with batteries of all kinds for radio work. This work, as editorials and articles we have published heretofore certainly indicate, is in our minds both valuable and interesting—work which we have gone a long way off the beaten path to encourage. In the light of present-day enterprise an advance in any branch of industrial activity usually results in a necessity for rearrangement of existing methods which the more recent development is designed to improve or replace, rather than total abolition of older methods. The most efficient method of radio receiver operation, obviously, is the method which will produce the best results at the lowest cost. The estimate of cost should include purchase price and upkeep and in these days of luxury it would seem reasonable to include convenience as part of the service the device must render.

All of these much mooted questions have, to a certain degree at any rate, been glossed over by most radio editors while the manufacturers of storage batteries and current tap devices have to a marked degree been gnawing at each other's throats.

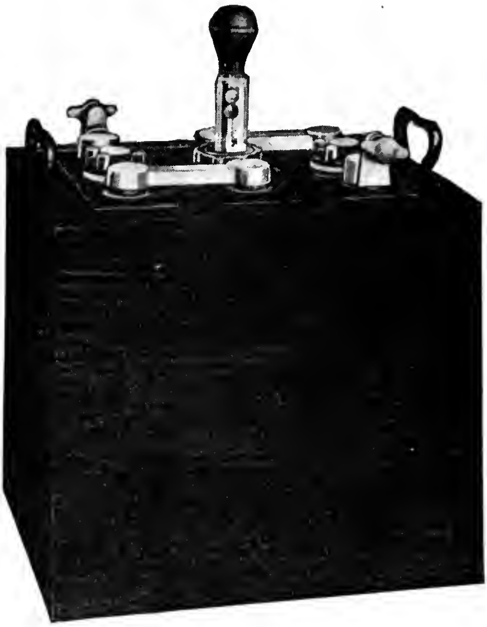
We are convinced that there is room in the field for all three systems of plate and filament supply and feel that the publication of articles like this one will let our readers know that the makers of our old friends, the dry and storage batteries, have not been entirely asleep. They have made radical improvements in their products which have made the storage battery a clean enough device to grace our living rooms and have developed a system of charging which is almost automatic. Batteries are still very important elements in radio, and it is very likely that they always will be.—The Editor

THERE was a time when the radio enthusiast went to his favorite radio shop and bought merely a storage battery for his set. Now he is more critical, for he knows that the storage battery has been carefully and excellently adapted to the uses of radio by progressive manufacturers. When the vacuum tube first came into use and storage batteries were required to light their filaments, the only battery which could be had was the heavy and unwieldy and certainly unbeautiful battery then used for ignition purposes. The acid leaked through the vents in the sticky top of the cell and the wood case was itself often acid soaked. Then, the storage battery had to be carefully disposed indeed, for few carpets and rugs were proof against its acid invasions.

Now the storage battery has been modified and altered so that it is really suited for radio. It is essentially the same old storage battery and it works on the same tried and true chemical principles as before the battery got all dressed up for its radio uses.

With the new models of storage batteries recently brought out by several manufacturers, it is unnecessary to have any technical knowledge about the workings of storage batteries. It is entirely unnecessary to worry about such deep technical mysteries as current rates, overcharging, and reverse charging.

Many of these batteries are now manufactured with glass cases so that the complete condition of the cell can be seen at all times. Some contain a charge and discharge indicator, in the form of two colored indicator balls. These are so designed that they indicate the condition of the cells at all times. When both of these indicators are floating, the battery is charged. When one sinks and the other floats, the battery is partially discharged and when both sink, the battery is nearly discharged. During the charging process, this action is reversed. First one ball floats when the battery is more than half charged. Later, the other floats, which indicates that the recharging of the battery has been completed.



THE OLD TYPE

Of battery to which the name "radio" was applied by makers of auto lighting batteries when the demand for radio batteries came upon them. Though a perfectly good battery for other purposes, it does not fill the bill for radio as a comparison with the other illustrations will disclose

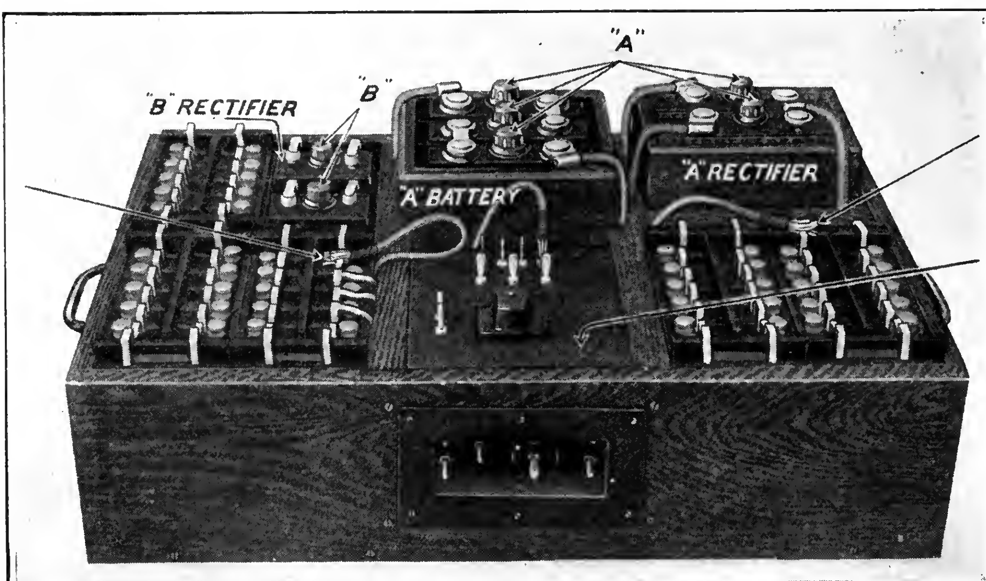
KEEPING THE ACID IN ITS PLACE

MODERN radio storage batteries are designed so that almost no spray escapes from the battery. Everybody knows that a mere trace of acid turns blue litmus paper red. One manufacturer claims that his storage battery for radio use stays so dry and free from acid on top that a piece of blue litmus paper placed over the vent cap will not turn red.

Of course, this all implies that the unit shall be properly charged, but here again, the radio user, no matter how inexperienced, has nothing to worry about. Chargers can now be purchased with a current rate so low that even if the battery remain on charge long after it is fully charged, no harm can result. The battery therefore cannot overheat.

CHARGING THE BATTERY

FOR small A batteries of about 15 to 18 ampere-hour capacity, such as would be used to supply the filaments of peanut tubes, a ½-ampere charger is sufficient. For a 30 to 50 ampere-hour A battery supplying standard 6-volt tubes, a one-ampere charger is satisfactory. A batteries whose capacity is from 80 to 100 ampere-hours, use a one- or two-ampere charger. For storage A batteries of size larger than this, a two- or five-ampere

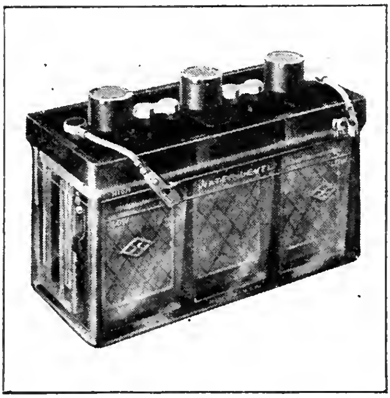


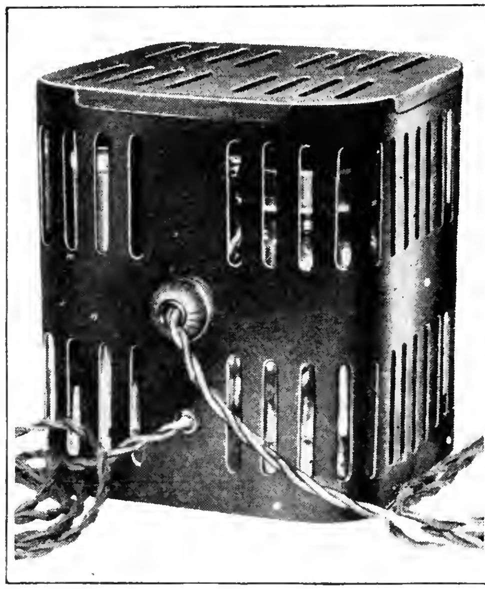
ALL IN ONE

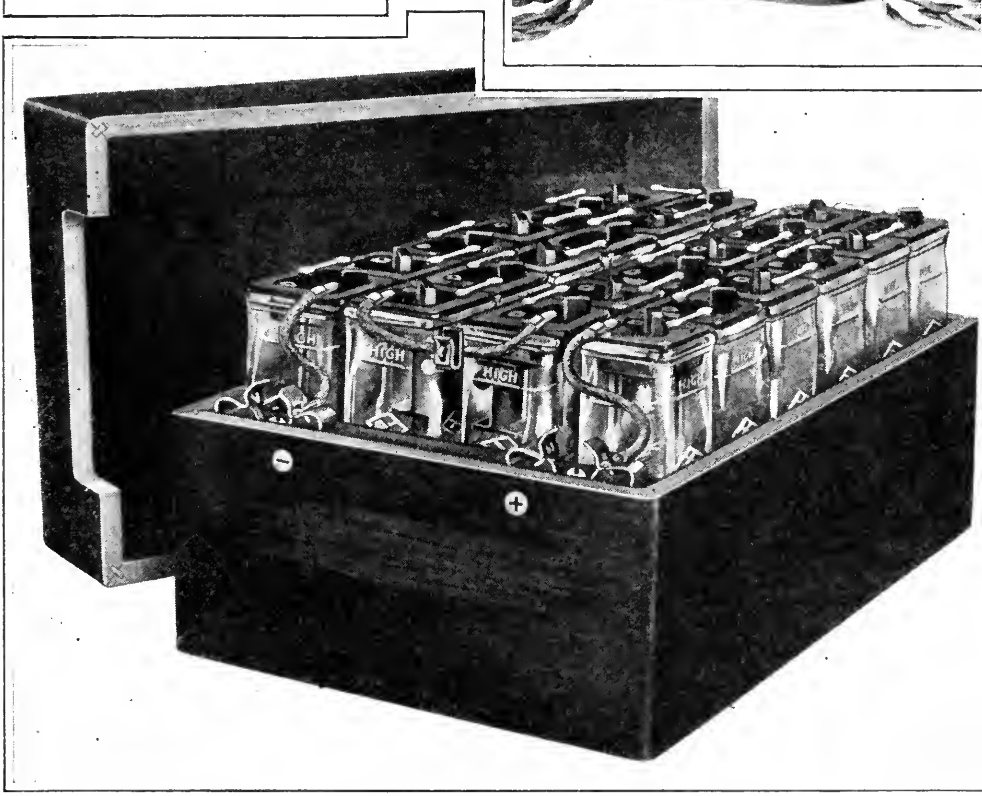
Storage A, storage B batteries with plugs for varying the voltage at will. The A charger and B charger and switching device make it possible to use batteries with this unit and operate it directly from an alternating current light socket

charger will charge gently enough to insure against acid spray or overheating.

Since radio storage batteries have been so refined there is no reason why they cannot be charged as well as discharged in the same room in which the radio receiver is located. It is almost a waste of energy to carry one of the newer batteries to a service station for recharging when it is possible to perform that operation in the home at a minimum of expense. Separate chargers can be purchased







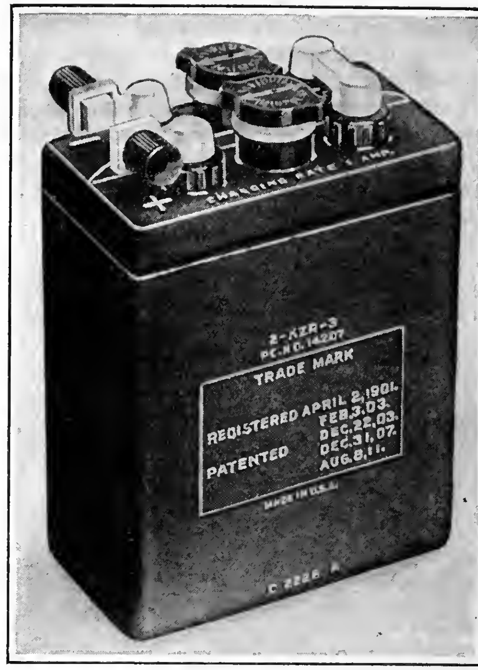
ANOTHER COMPLETE UNIT

Comprising storage A and B batteries with chemical low-rate charger and convenient switching arrangement for charging and operating. Here the manufacturer has made an effort to keep pace with the demands made upon him by discriminating purchasers. A radio supply system of this type is clean, easy to operate, and quite satisfactory

and wired so that when the battery is run down from continued use, a switch may be thrown and the battery charged. If the purchaser wishes, he may buy a complete storage battery and charging unit combined.

The glass case of most of the present radio storage batteries allows the user to see at all times the proper height of the electrolyte and a constant check can be kept on its condition. Because of the avoidance of overheating during the charging process and proper design of the vent caps in the top, the water in the solution evaporates quite slowly and refilling is necessary only at very infrequent intervals.

When a low-rate charger is used, the battery must obviously be charged at more frequent intervals than if the charging rate is high, say five amperes. With the charging unit connected so that charging and discharging is merely a matter of throwing a switch from one side to the other, frequent charging at a low rate is no especial hardship. Also, it actually costs less for current to charge slowly and easily at a low rate than fast and furiously at a high rate. When one overheats a battery by leaving it too long with a charger too big for it, one has to pay for the current which generates this utterly useless and harmful heat.



A SMALL STORAGE BATTERY

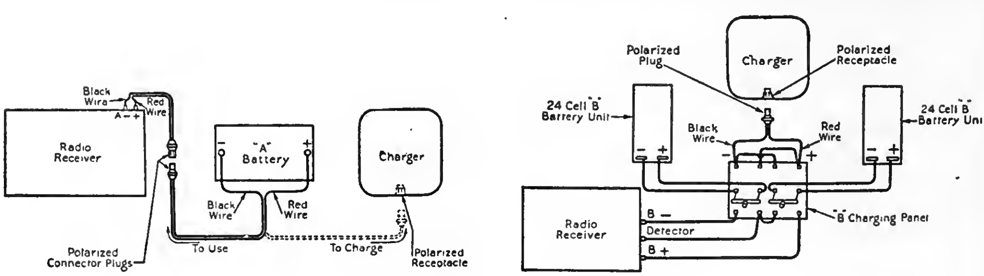
Made with a rubber case and a view to portability. Such a battery may well be used with the smaller tubes, requiring 3 volts for filament operation. It is rugged, clean, and not too expensive

PLACING AND USE OF THE BATTERY

GLASS cased storage cells can very easily and neatly be placed inside radio cabinets, and some of the late models of complete cabinet receivers contain glass cased storage cells which are used for continuous service with no annoyance from spilled acid.

Storage batteries have the advantage of maintaining a quite constant, even voltage. This variation is not more than ten per cent. from the start to finish of a discharge, and less than five per cent. if the battery is kept pretty well charged at all times with frequent boosting with a low rate charger. In the A battery circuit of a receiver, uniform voltage minimizes the danger of shortening the life of tubes at first by overheating filaments, and against weak signals through underheating of the tube filaments later on. Uniform filament voltage also makes the filament rheostat settings on a receiver the same for any one station from one day to the next.

Steady voltage of the B battery circuit is even more desirable than in the A circuit.



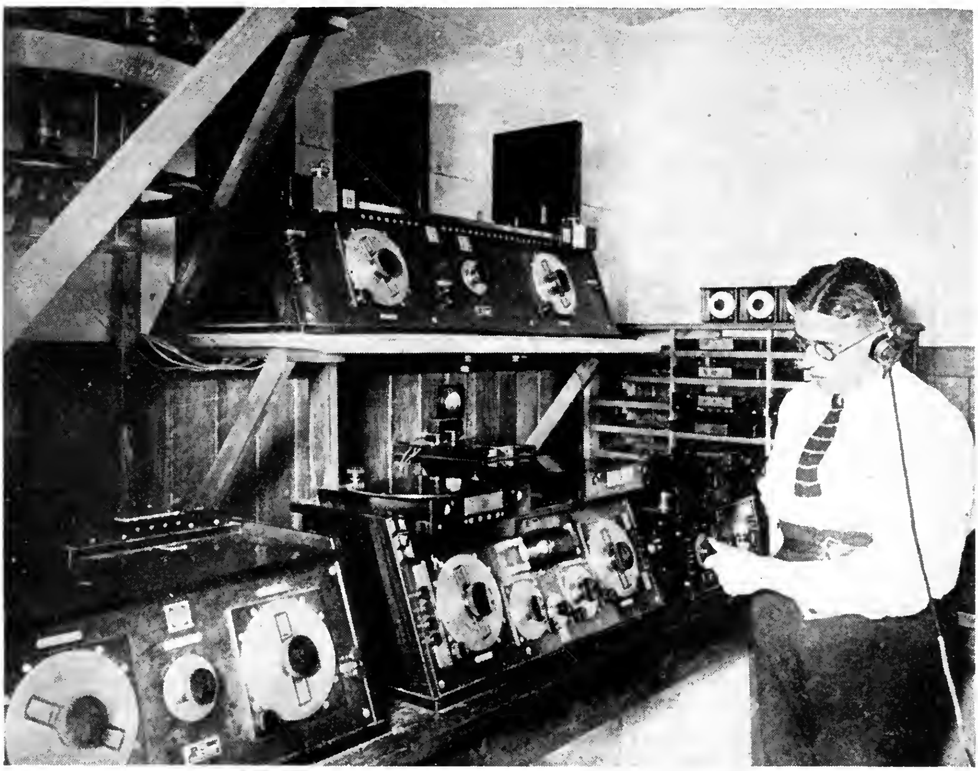
SWITCHING CONNECTIONS

For charging storage batteries used with radio receivers. The diagram on the left shows a convenient method for charging a radio A battery and the complete one on the right shows a method very generally used for B battery charging

Storage B batteries give steady, uniform voltage which is desirable.

Storage batteries are not overly expensive. A high grade A battery and charger (the filament supply for peanut tubes) including plugs and sockets for permanent switching connection costs about $18. A larger size for standard 6-volt tubes can be bought for a little more than $30, which also includes a charger and switches. A 96-volt B battery costs about $27.50 to $40.00, according to its size and finish. Most A battery chargers are designed to charge B batteries as well, or they can be so adapted.

To charge a 96-volt B battery of 3000 milliampere-hours capacity costs about ten cents. The expense of keeping an A battery charged is very slight. And a properly built storage battery will last for years with practically no outlay for repairs.



RECEIVING TRANSATLANTIC COMMERCIAL RADIO TRAFFIC

In the station at Nauen, near Berlin, Germany. Nauen, POZ, is the single most powerful station in that country and transmits commercial traffic directly to many countries. The handle of a large receiving loop is in the upper left corner

WHEN YOU WRITE THE GRID . . .

Don't fail to enclose a stamped, self-addressed envelope with your inquiry if you expect a personal reply.

Don't be impatient if you do not receive an immediate answer. Every letter is answered in the order of its receipt. Do not send a second letter asking about the first.

Look over your files of RADIO BROADCAST *before asking a question which might have been covered in a previous issue.*

Don't ask for a comparison between manufactured apparatus. The addresses of manufacturers of articles used in the construction of apparatus described in RADIO BROADCAST *will be given on request.*

Don't include questions on subscription orders or inquiries to other departments of Doubleday, Page & Co. Address a separate inquiry to The Grid.

Don't send us a fee for answering your questions. The Grid Department is maintained for the aid and convenience of readers of RADIO BROADCAST *and there is no charge for the service.*

QUERIES ANSWERED

WHAT IS BODY-CAPACITY AND HOW MAY IT BE ELIMINATED?

L. C. M.—Berkeley, Calif.

WHAT KIND OF AN ANTENNA DO YOU SUGGEST FOR ORDINARY RECEIVING PURPOSES?

F. E. C.—Kansas City, Mo.

MAY I HAVE A CIRCUIT DIAGRAM FOR ADDING A STAGE OF RADIO-FREQUENCY AMPLIFICATION TO THE ROBERTS CIRCUIT?

J. H. M.—Washington, D. C.

MY RECEIVER WILL NOT TUNE TO THE LOWER WAVELENGTHS. HOW MAY I REMEDY THIS CONDITION?

I. N.—Madison, Wisc.

WHERE MAY A BY-PASS CONDENSER BE ADDED TO ADVANTAGE IN AN AUDIO-FREQUENCY AMPLIFIER CIRCUIT?

S. P.—Nashville, Tenn.

WILL YOU EXPLAIN, IN DETAIL, THE APPLICATION OF FORMULAS GOVERNING THE CALCULATION OF RESISTANCE AND CAPACITY?

W. K.—Portland, Oregon.

MY HOME IS EQUIPPED WITH 110 VOLTS DIRECT CURRENT. HOW MAY I CHARGE MY STORAGE BATTERY WITH IT?

R. R. T.—New York City.

BODY-CAPACITY EFFECTS

HOW many people there are who have to be told that when there is trouble in a receiver it may usually be traced to some definite source!

The effects of body-capacity are no exception to the rule.

Generally speaking, body-capacity may be termed that effect which when the hand of the operator is brought near the tuning dial or other parts of the tuning circuit, causes the receiver to become detuned from the signal being received. It may be further placed as an electrostatic effect altering the inductance-capacity value of the tuning circuit.

Some receivers employ metal shielding fastened

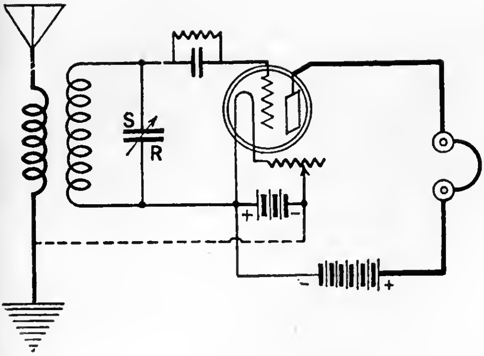


FIG. 1

on the panels behind the tuning dials as a remedy for this condition. That is only a remedy.

To put the receiver into proper operating condition it would be well to follow a logical trouble-shooting plan. One should look to see if the stationary plates of the condenser are not tightly connected to the grid of the tube, and to see that the negative side of the filament is properly connected to ground. Grid and plate leads should be so arranged that they do not run parallel and close together.

The placement of the parts constituting the tuner circuit also adds to the possibilities of body-capacity effects and may be forestalled by a painstaking preliminary set-up and test of the circuit.

In all circuits it is advantageous to bunch the filament and B battery supply wires so that the grid and plate terminal leads may be as short and direct as possible.

In Fig 1 are incorporated the ideas as outlined here.

ANTENNAS

MANY times this department is asked about the advisability of erecting antennas of questionable design and makeup. The uni- and vari-directional types, multi-strand, and the new braid-ribbon arrangements all come in for their amount of querying.

The ordinary receiving conditions, which, in the end, interest the majority of broadcast listeners, require simply a single strand of antenna wire erected in as straight a line as possible.

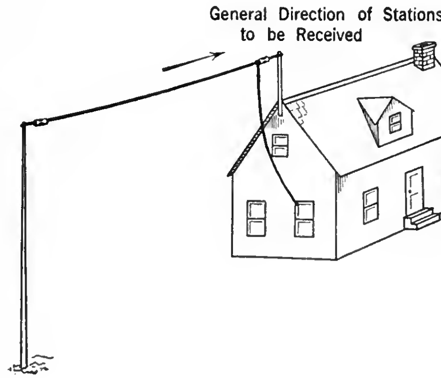


FIG. 2

It has been argued pro and con as to the special merits of the placement of the lead-in tap-off but we advise bringing the lead-in from the end of the antenna which generally points in the direction of the stations to be received. See Fig. 2.

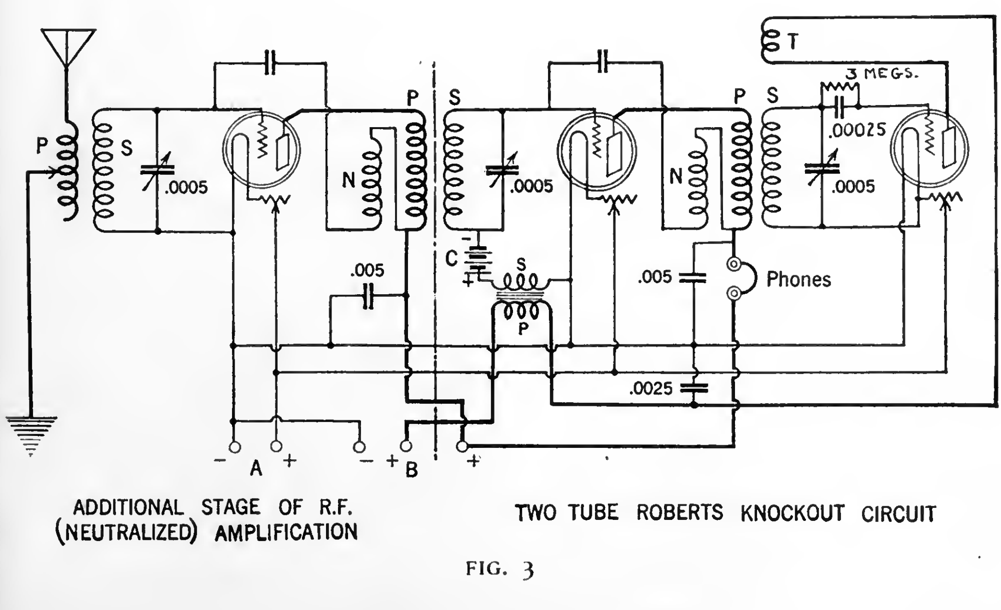


FIG. 3

A STAGE OF RADIO FREQUENCY FOR THE ROBERTS RECEIVER

FOR those who wish to add a stage of neutralized radio-frequency amplification to the Roberts circuit we show the circuit in Fig. 3. From this circuit it will be seen that the antenna coupler which was previously connected before the tube No. 2 is now placed before tube No. 1. It then becomes necessary for us to provide the radio-frequency coupler between the first and second tubes. Like the other radio-frequency coupler it has a double wound primary constituting the plate coil and the neutralizing coil which is connected back through the condenser to the grid of the tube. The necessary parts for this addition are, the r. f. coupler (as explained), the neutralizing condenser, a socket, a rheostat, and a .005 mfd. fixed condenser.

TUNING TO THE LOWER WAVELENGTHS

WHERE, the condition exists in a receiver, that makes tuning at the lower wavelengths difficult or even impossible it is well to incorporate the improvement as outlined in Fig. 4.

By making a tap-off on the tuner coil and bringing

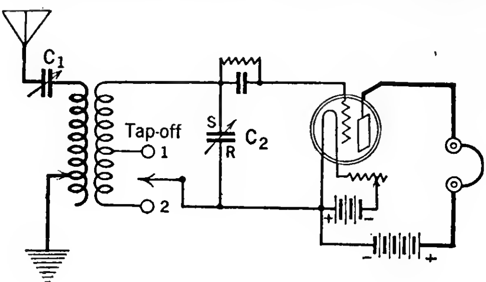


FIG. 4

the lead to a switch point it is possible to cut in or out, by means of the switch arm, a section of the entire inductance.

Naturally enough, when the switch arm is placed on tap No. 1 the lower section of the coil is cut out

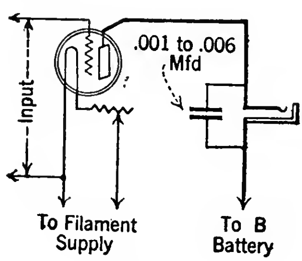


FIG. 5

of the circuit and the condenser C2 shunt only that part of the inductance between switch point No. 1 and the grid of the tube. The wavelength range of the receiver at this setting will be shifted down. That is to say at minimum capacity the wavelength will be lower than if the whole coil were in the circuit. Similarly when the condenser is at a maximum capacity value the wavelength setting is lower than when the switch is on point No. 2.

It will also be noted that with the switch on point No. 1, the positions of stations transmitting on the comparatively low wavelengths will be spread out over the tuning dial which facilitates their reception.

The insertion of the variable capacity C1 offers a means for sharply tuning the antenna circuit to the incoming signal. However, its use is not absolutely necessary and may be required only where the antenna is exceptionally long.

A BY-PASS CONDENSER FOR THE LOUD SPEAKER

TO OBTAIN that fullness of tone so much desired of all loud speakers, it has been observed that a fixed condenser shunted across the output terminals of an audio-frequency amplifier will often do the trick.

The circuit showing the position of the condenser

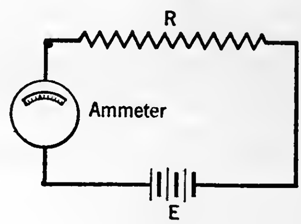


FIG. 6

is depicted in Fig. 5. The value of the condenser (better determined by test) usually varies between .001 and .006 mfd. In some instances that side of the by-pass condenser connected to the B battery is better situated on the negative than on the positive terminal of this battery.

RESISTANCE AND CAPACITY FORMULAS

NOW to digress and to go from the practical to the theoretical.

The computation of resistance, capacitance, and inductance values is of interest and importance to the experimenter who proceeds not along on hunches but on carefully laid plans.

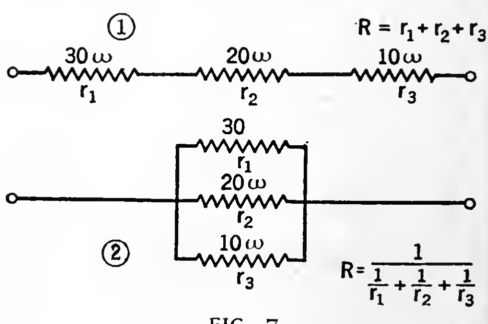


FIG. 7

MAGNAVOX

Reg. U.S. Pat. Off.

The name to look for when buying radio equipment.

TRF-5

ONE hand on ONE dial for *Tuning in!*

EVEN though the Magnavox single dial Station Selector has displaced the "old style" complicated tuning arrangements, this remarkable feature *alone* would not have merited the praise which every owner gives his Magnavox Set.

It is by its sheer *musical quality*, in addition to its unusual simplicity, that the Magnavox 5-tube tuned radio frequency circuit retains the user's lasting admiration.

As pioneers in the design and manufacture of radio reproducers, Magnavox engineers were thoroughly equipped to master the problem of beautiful tone.

If you already own a receiving set, a Magnavox Reproducer will wonderfully enhance its daily usefulness for family and friends.

Ask the nearest Registered Magnavox Dealer to demonstrate Magnavox Radio equipment

Magnavox Receiving Sets

TRF-5 (as illustrated) encased in carved mahogany cabinet; price includes M4 Reproducer . . $125.00

TRF-50 in carved mahogany period cabinet with dust-proof doors and built-in Magnavox Reproducer $150.00

Semi-dynamic Reproducer

M4—the most efficient unit ever designed to operate without external battery, $25.00

Electro-dynamic Reproducer

The original radio reproducer, famous throughout the world. With Volume Control.
R3, $35.00
R2, $50.00

THE MAGNAVOX COMPANY, Oakland, Calif.

New York: 350 W. 31st St. *Chicago:* 162 N. State St.

Canadian Distributors: Perkins Electric Limited, Toronto, Montreal, Winnipeg

★

MAGNAVOX *Radio*

3R

At a later time we will discuss the computation of inductance. Just now, let us consider the factors of resistance and capacity.

In computing the resistance of a coil of wire such as a rheostat it is necessary to make use of Ohm's Law which is expressed symbolically $R=\frac{E}{I}$ or, as written, the resistance in a circuit equals volts divided by amperes.

By transposing, it is possible to obtain a formula

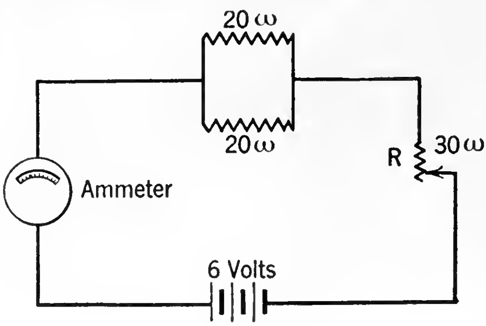


FIG. 8

for finding the other two values, namely E and I, as follows:

$E = I \times R$

$I = \frac{E}{R}$

Now in Fig. 6 we have a circuit containing the resistance R and the battery supplying the voltage, E. The ammeter will register the amperage of the circuit. Assuming that the battery delivers 6 volts and the resistance has a value of 30 ohms, then, substituting these values in Ohm's Law the formula would read $I=\frac{6}{30}$ or .2 amperes.

To determine the resistance of the filament of a tube the same law may be employed. For instance, in the UV-201-A the filament voltage as stated by the manufacturers is 5 volts and the amperage at which its best operation is obtained is .25 amperes. Then substituting values in the formula $R=\frac{E}{I}$, $R=\frac{5}{.25}$ or $R=20$. Therefore the resistance of a UV-201-A filament is 20 ohms.

Where several resistances are used in a circuit, their total resistance may be obtained by the application of other formulas depending upon the particular type of hook-up.

When resistances are connected in series (1, Fig. 7) the total resistance value equals the sum of all. The formula is expressed $R=r_1+r_2+r_3$.

For resistances in parallel another calculation is necessary. Here is the formula: $R=\frac{1}{\frac{1}{r_1}+\frac{1}{r_2}+\frac{1}{r_3}}$

Substituting the values as shown in 2 Fig. 7, $R=\frac{1}{\frac{1}{30}+\frac{1}{20}+\frac{1}{10}=\frac{1}{11}}$ or 5.4 ohms.

When the current in a circuit must pass through several resistances in series the amperage is less than if only one of the units were used.

However, from the formulas it may be seen that this is not true when the resistances are connected in parallel. The reason here is evident. Due to the units being in parallel three paths are afforded to the flow of current. The same effect would be obtained by the use of a larger wire, the resistance of which is lower than smaller sizes.

In Fig. 8 we have the combination of resistances in series-parallel. The two 20-ohm resistances are in parallel while the resistance R of 30 ohms is is series in the entire circuit. To find the amperage of the entire circuit first compute the total resistance of the two parallel resistances (10 ohms), Then $10+30=40$ ohms total resistance of the circuit. Therefore $I=\frac{6}{40}$ or .15 amperes.

This will indicate that when all the resistance (if it be variable in the form of a rheostat) is included in the circuit .15 amperes of current will flow through. By reducing the value of resistance the amperage will vary to a maximum of .6 amperes.

To calculate the resistance of a rheostat necessary to control a tube circuit the following formula will prove helpful: $R=(\frac{E}{I})-rf$

where R—resistance of rheostat
E—voltage of battery
I—current rating of tube
rf—resistance of the filament

Interpreted, this formula would be expressed thus: to obtain the value of resistance of the required rheostat divide the voltage of the battery by the current rating of the tube. From this quotient substract the resistance of the filament.

By an inspection of the formulas and circuits as outlined in Fig. 9 it will be seen that they are similar to those for resistance computations with the exception that they apply to the opposite condition. That is to say, the total capacity of con-

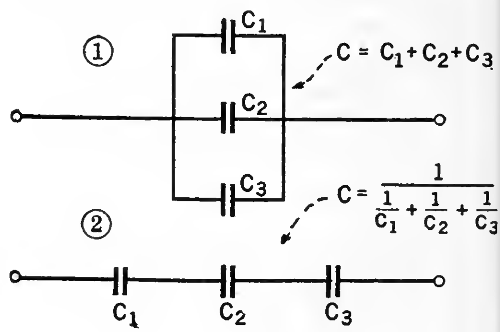


FIG. 9

densers in parallel as in 1, Fig. 9 is equal to the sum of all, while the total value of resistances in parallel is equal to the sum of the reciprocals.

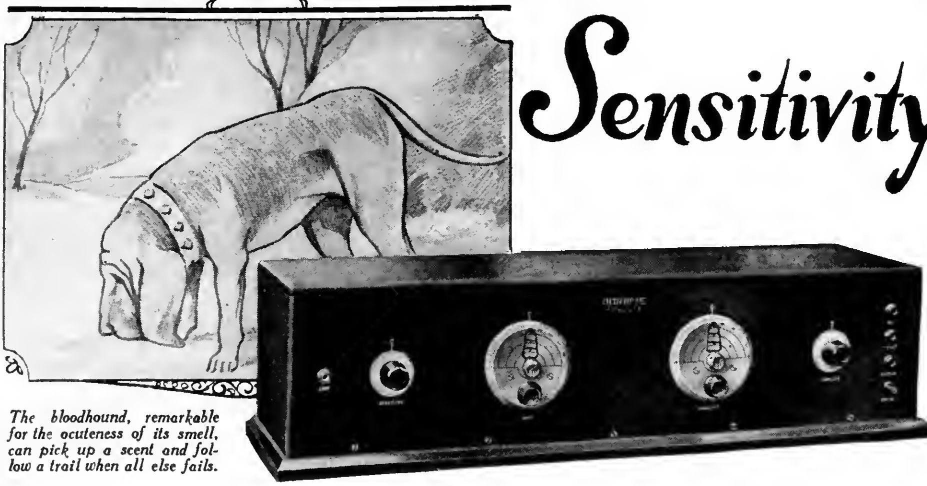
As an example: 3 condensers, each of .002 mfd, in parallel would equal .006 mfd. Three condensers of .006 mfd. in series would equal .002 mfd.

CHARGING STORAGE BATTERIES WITH 110 VOLTS D. C.

HERE again the knowledge of Ohm's Law plus another formula, that of power equation, will prove of aid.

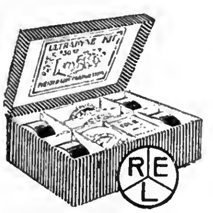
The power expended in a circuit performing a

Sensitivity



The bloodhound, remarkable for the acuteness of its smell, can pick up a scent and follow a trail when all else fails.

-never before thought possible!



THE ULTRADYNE KIT

Consists of 1 Low Loss Tuning Coil, 1 Special Low Loss Coupler, 1 Type "A" Ultraformer, 3 Type "B" Ultraformers, 4 Matched Fixed Condensers.

To protect the public, Mr. Lacault's personal monogram seal (R.E.L.) is placed on all genuine Ultraformers. All Ultraformers are guaranteed as long as this seal remains unbroken...... **$30.00**

How to Build and Operate the ULTRADYNE

32-page illustrated book giving the latest authentic information on drilling, wiring, assembling and tuning the Model L-2 Ultradyne Receiver **50c**

With the extreme acuteness of the bloodhound's scent, the Model L-2 Ultradyne detects the faintest broadcast signals—signals that are "dead" to other receivers—regenerates and makes them audible on the loud speaker.

It's here, where the development of other super-radio receivers has halted, the Ultradyne forges ahead.

The unusual sensitivity of the Model L-2 Ultradyne is due to the successful application of regeneration, to the famous Modulation System of radio reception, recently perfected by R. E. Lacault, E.E., A.M.I.R.E., Chief Engineer of this Company and formerly Radio Research Engineer with the French Signal Corps Research Laboratories.

It's this development, an exclusive feature of the Model L-2 Ultradyne, that makes it possible to receive greater distance on the loud speaker.

Everything that the Model L-2 Ultradyne means in actual results and genuine satisfaction you will appreciate the first evening you operate it.

Write for free descriptive folder

★ **ULTRADYNE**

MODEL L-2

PHENIX RADIO CORPORATION

5-7 Beekman Street New York

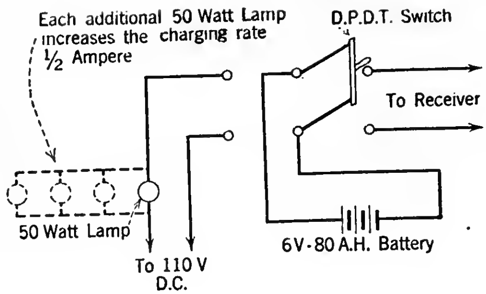


FIG. 10

certain work is equal to the voltage supplied multiplied by the amperage flowing through. This is expressed: power equals voltage times amperage. The designation of power in electrical and radio terms is watts. Symbolically the formula is expressed $W = E \times I$.

Now for the battery charging.

A storage battery must be recharged at a definite amperage rate. Usually the manufacturers of batteries designate this charging rate on the name-plate fastened on the battery.

Generally it does not exceed 8 amperes. Theoretically it is necessary to put back into the battery just as many "amperes of current" as were taken out by the discharge.

The capacity of a battery is rated in ampere hours. Explained, this means that an 80-ampere hour battery may be discharged at 4 amperes for 20 hours, 2 amperes for 40 hours or 8 amperes for 10 hours.

Therefore in recharging it is necessary to charge the battery for a certain period of time the length of which depends upon the amperage rate of charge. For instance, a fully discharged 80 ampere-hour battery must be recharged for 80 hours at 1 ampere; 40 hours at 2 amperes; 20 hours at 4 amperes and so on.

Ordinarily a battery is not completely discharged and only requires a short time charge or as is correctly termed, a trickle charge.

Fig. 10 shows a circuit for charging a storage battery at a trickle-charge rate.

To increase the rate of charge it is necessary to parallel additional 50 watt lamps to that shown. The addition of each lamp increases the charging rate one half an ampere.

Other charging rates with various sized lamps may be computed from the power formula as previously explained.

This power formula is given as an aid in determining the resistance values of various sized lamps. It may be transposed as follows: $I = \frac{W}{E}$, and $E = \frac{W}{I}$

Given the wattage of the lamp and the voltage of the line it is a simple matter by substituting values, to calculate the value of amperage.

Then, knowing the amperage and voltage, the resistance of the lamp filament may be computed. Therefore knowing the resistance and the voltage in the charging circuit it is a matter of calculation to determine the value of the current in amperes flowing through the charging circuit.

As an example, using a 75 watt lamp in a 110 volt charging circuit: $I = \frac{W}{E}$ or $I = \frac{75}{110}$ or .68 amperes.

Then $R = \frac{E}{I}$ or $R = \frac{110}{.68}$ or 162 ohms (approximately)

Therefore $I = \frac{E}{R}$ or $I = \frac{110}{162}$ or .68 amperes. The amperage of the charging circuit is equal to the computed amperage value of the lamp derived from the power formula.

This computation was carried through to its logical conclusion as a proof and also as an indication that the last calculation is unnecessary, the charging rate being determined by the current rating of the tube where only one is used.

HOW TO FIND TROUBLE

As an aid in determining and locating defects and trouble in any type of receiver the following list of trouble-shooting pointers will be found helpful.

Many of the tests to determine the causes of trouble require only a pair of phones and a battery, C, B, or A.

Continuity of circuits, short circuits, open circuits and leakages may be located by arranging a test circuit merely consisting of a pair of phones to which has been added a battery inserted in series with one side of the phone lead. The other lead and the remaining terminal of the battery are connected to pointer leads so that they may be touched to the terminals of units to be tested.

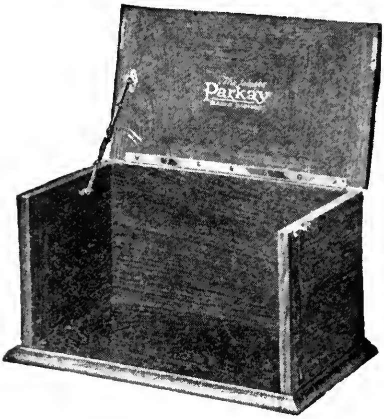
Trouble-shooting may be divided into several classes

1—Battery circuits
- A—If the tubes light to full brilliancy the filament battery is O. K. This may further be determined by the use of a hydrometer.
- B—B batteries may be tested for full life by noting the volume of the click when a pair of phones are momentarily touched to each of the output terminals of each block. This test is not recommended, but is merely suggested if a voltmeter is not available to register the voltage of the battery.

2—Tuning circuits
- A—The antenna circuit of the coupler coil may be tested with the phone battery tester for continuity of the circuit.
- B—Inspect antenna and ground connections.
- C—Have antenna and ground leads insulated from other objects.
- D—Secondary of coupler may be given circuit continuity test.
- E—Condenser shunting the secondary should have the rotor connected to the filament and the stator should connect to the grid of the tube.

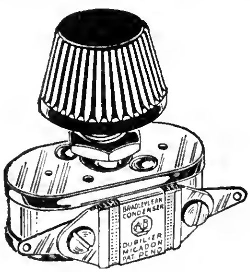
3—Audio-Frequency units
- A—Try reversing the primary leads. Also the secondary leads.
- B—Give each winding continuity test. Here the primary will click louder than the secondary.
- C—Try grounding the metal cores to eliminate squealing.
- D—Make use of by-pass condensers to round out the tone quality. They should be placed across the primaries or across the phone output.

New Equipment



A CABINET

Of neat design and sturdy construction is presented in this Jewett Parkay cabinet. It is a well finished article which should please even the most particular. Made by The Jewett Radio & Phonograph Co., 5672 Twelfth St., Detroit, Mich.

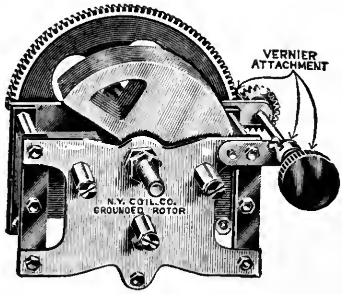


THE BRADLEYLEAK

This instrument combines a smooth action variable grid leak with a grid condenser in a compact and efficient manner. It is possible to mount this unit on a base board, subbase, or panel without difficulty. Made by the Allen-Bradley Co., 278 Greenfield Ave., Milwaukee, Wis.

TITAN B BATTERY

Here we have a 48-volt storage B battery designed to give long and satisfactory service. It is possible to tap off for any desired voltage. The cells are contained in heavy glass jars and as a unit have a capacity of about 6000 milliampere hours. Made by the General Lead Battery Co., Chapel St. and Lister Ave., Newark, N. J.



N. Y. COIL CO. CONDENSER

A condenser with cone type bearings insuring smooth action and long service. The grounded rotor eliminates hand capacity. "Straight line" capacity is obtained by cutting away a portion of the rotary plates. Made by the New York Coil Co., 338 Pearl St., New York City

JONES MULTI-PLUG AND CABLE

A neat and efficient means of connecting batteries to the receiver. All leads are contained in a cable furnished with a keyed bracket which facilitates making connection or disconnection to the receiver by one operation. The design of the bracket makes it impossible to connect the leads wrong after once having the wires connected to the set. Made by Howard B. Jones, 614 South Canal St., Chicago, Ill.

BESTONE RECEIVER

A five-tube receiver of interesting design which is encased in a cabinet with built-in loud speaker and battery compartment. This compactness should be an attractive feature. Made by Henry Hyman & Co., Inc., 476 Broadway, New York City

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For a limited time, we offer you the privilege of buying these standard, well-known parts direct from our factory—at special introductory prices. Orders will be accepted subject to the conditions outlined below.

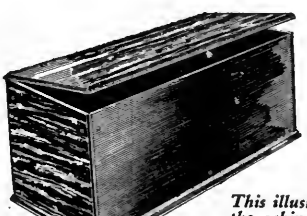
This offer expires on April 30, 1925.

Your money back if not satisfied

If your dealer does not stock and carry these parts, you may select a cabinet, and the panel to fit it, at the special introductory prices quoted.

In return for this privilege we ask you to send us your dealer's name and the names of three of your friends who are radio fans.

We shall refund your money without a whimper if you are not entirely satisfied with the goods when received.



★

This illustration shows the cabinet — with the panel in place.

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(2) 7 x 7 x 12	8.10	4.50
(3) 7 x 7 x 14	8.10	4.50
(4) 7 x 7 x 18	9.40	4.50
(5) 7 x 7 x 21	10.40	6.50
(6) 7 x 7 x 24	10 40	6.50
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Celoron will help you get better results from your radio hook-up. It will give your instruments thorough, leak-proof insulation.

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(4) 7 x 18 x 3/16	2.95	1.00
(5) 7 x 21 x 3/16	3.45	2.00
(6) 7 x 24 x 3/16	3.94	2.00
(7) 7 x 26 x 3/16	4.25	2.00
(8) 7 x 30 x 3/16	4.92	2.00

If your dealer does not carry Celoron, order by mail

In ordering please follow these simple directions:

1. Indicate on the coupon the size of the panel and the size of the cabinet you want.
2. Print in your name and address carefully.
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4. Mark on the white sheet the name and address of your dealer and the names and addresses of three friends who are radio fans.
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6. Mail all papers to the Diamond State Fibre Co., Bridgeport, Penn.

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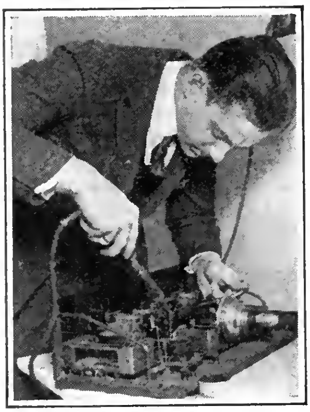
Among Our Authors

D. C. WILKERSON

FOR a number of years Dan C. Wilkerson has been closely associated with the Army Air Service in Washington and has done considerable technical work with radio and airplanes. He is a resident of Washington and a quite frequent writer of radio articles.

PHIL FAY built his first radio set in 1911 and has never since, like a lot of us, recovered from the first infusion of the radio virus. He writes considerably for the newspapers on various radio subjects, but RADIO BROADCAST is the first magazine to have an article under his name. Mr. Fay is responsible for the design of many of the essential little accessories for radio receivers which are familiar to every fan.



PHIL FAY

H. D. KELLOGG is a native Philadelphian and a graduate of Yale in the class of 1923. Although he won the prize of $500 offered by this magazine for what the judges decided was the best answer to the problem of who is to pay for broadcasting, he is not actively occupied in radio. Mr. Kellogg says, however, "I have followed with great interest the development of radio communication, particularly the outstanding developments of the last few years which have come with the advent of broadcasting." He feels that there is a growing difficulty which broadcast station directors are facing in securing good talent to appear at stations without payment for their services.

CARL DREHER, in addition to being the excellent radio man that he is, writes articles which insinuate themselves into such august covers as are found on Henry Goddard Leach's *Forum* and the expressive Mr. Henry L. Mencken's *American Mercury*. Mr. Dreher was a visitor at the offices the other day and outlined some of the plans he has for "As the Broadcaster Sees It." If he manages to put in print the ideas he has, life will certainly be more interesting for both the broadcaster and those who like to know what broadcasters are doing.

W. R. BRADFORD contributes one of his excellent radio cartoons and an article about his attack on the Roberts Knock-out receiver to the magazine this month. His method of attack is strangely more like an electrician's than a cartoonist's, but perhaps this is just another anomaly. The accompanying photograph is one of himself taken by himself—which certainly makes it a one-man affair.

W. R. BRADFORD
Self-photographed as his grandmother

Montiero, Forest Hills
J. E. MILLEN

J. E. MILLEN is a senior at Stevens Institute of Technology at Hoboken but he finds some spare time occasionally to write about radio and experiment with it.

ALTHOUGH at present an enthusiastic Chicagoan, McMurdo Silver was born in Geneva, New York. Now Geneva is otherwise famous for two things: it contains Hobart College and is not far from Cornell University at Ithaca. They also make cutlery there, if we remember the geographies correctly. Mr. Silver is designing, manufacturing, and selling radio equipment.

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EVERY TUESDAY AT 9 P. M.
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WJAR	Providence	WCAE	Pittsburgh
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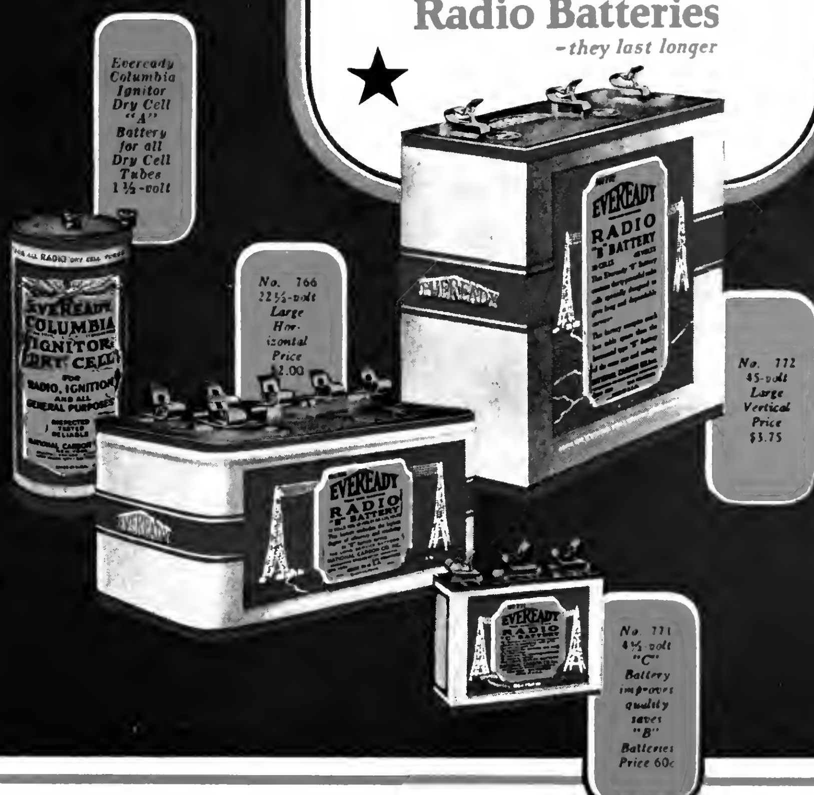
-they last longer

★



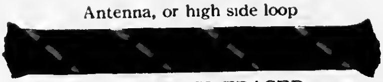
Standard Color Designations for Cords Used for Outside Connections in Radio Receivers

As Adopted by

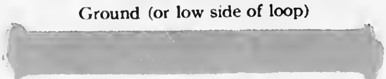
The Associated Manufacturers of Electrical Supplies

Simple Cord Color Combinations

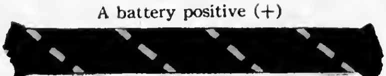
BLUE
Antenna, or high side loop



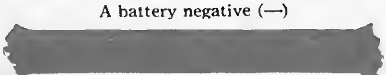
BLACK, BLUE TRACER
Ground (or low side of loop)



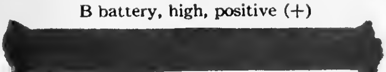
YELLOW
A battery positive (+)



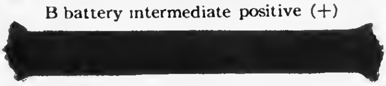
BLACK, YELLOW TRACER
A battery negative (—)



RED
B battery, high, positive (+)

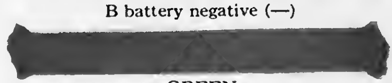


DARK RED
B battery intermediate positive (+)

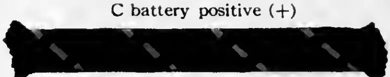


MAROON
B battery, detector positive (+)

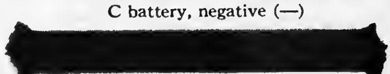
BLACK, RED TRACER
B battery negative (—)



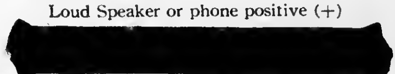
GREEN
C battery positive (+)



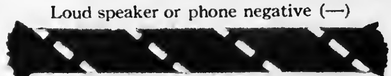
BLACK, GREEN TRACER
C battery, negative (—)



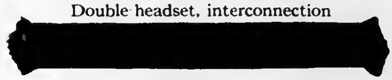
BROWN
Loud Speaker or phone positive (+)



BLACK, BROWN TRACER
Loud speaker or phone negative (—)



BROWN, WHITE TRACER
Double headset, interconnection



BLACK
Battery Jumpers

Color Designations of Conductors Common to More than One Circuit

(Solid color is chosen to represent most positive lead)

RED, BROWN TRACER
B battery, high side (+)
Loud speaker, low side

YELLOW, RED TRACER
B battery negative (—)
A battery positive (+)

GREEN, YELLOW TRACER
A battery negative (—)
C battery positive (+)

Radio Broadcast presents for the first time in any magazine the colors to be used in dyeing the braid used in the cord. Solid colors are to be used to designate the high or positive side of a circuit. Tracer colors are to be used to designate the low or negative side. The shade designations, in parentheses, are the same as those specified in the Standard Color Card of America, 6th edition, published by the Textile Color Card Association of the United States, Inc., 50 West 42nd Street, New York.

The general scheme is:
- Blue for the antenna circuit (Bluebird S-6065)
- Red for B battery (Geranium S-2035)
- Maroon for B battery (Magenta S-7285)
- Yellow for filament circuit (Orange S-3005)
- Green for C battery (Emerald S-5005)
- Brown for telephone circuit (Gold Brown S-3285)

In using these designations, always be guided by the point to which the flexible cord is attached, not where it leads to. For instance, a cord connecting the positive side of the B battery to the high side of the loud speaker jack should be marked red.

RADIO BROADCAST

Vol. 6, No. 6 April, 1925

How Radio Is Being Standardized

Order for the Radio Chaos—Facts About a Progressive Step Taken by the Associated Manufacturers of Electrical Supplies Involving Batteries, Connecting Cords, Plugs, and Jacks

By G. Y. ALLEN

STANDARDIZATION in nature is universal. It is essential to the existence of the universe and to the existence of life in all forms. If the law of mutual attraction of worlds should change one iota, their present orderly movement would degenerate into hopeless chaos. With the laws of nature so firmly standardized, it is not strange that man in applying these laws should find that standardization is essential.

Standardization of a new art must go hand in hand with its development. If standardization is projected too far ahead of development it tends to hinder and choke such development because it is impossible to look far enough into the future to anticipate all phases of the development. On the other hand, lack of standardization is likewise a drawback.

> "I desire heartily to endorse the plan that you have outlined to me for having printed a chart in colors showing the standard color markings for radio receiver cords, as adopted by the Standards Committee of the Associated Manufacturers of Electrical Supplies. The widespread adoption of such a color code will be a great step forward in radio manufacture and will also be of substantial benefit to the broadcast listener in connecting up a receiver as well as to the repair man who is servicing the set.
>
> "I feel that the Committee is indebted to Doubleday, Page & Company for their kind offer to coöperate in preparing this chart, and I am sure that the publicity obtained through their magazine, RADIO BROADCAST, will be a very valuable factor in making the adopted standards widely used, thus resulting in simplifying the manufacture, installation, and maintenance of radio receivers."
>
> —ALFRED N. GOLDSMITH, *Chief Broadcast Engineer, Radio Corporation of America.*

The development of the air brake for railroads illustrates how standardization may seriously handicap the development of an industry through the impossibility of looking far enough into the future. The diameter of the train pipe for the operation of the air brake was decided upon long before the advent of the long freight train of to-day. For the short and comparatively light train, the size determined upon was adequate. When long, heavy trains came to be the rule, however, a larger size pipe was found to be desirable, but owing to the standard that had been set and due to the investment in rol-

ling stock using the smaller size pipe, a larger diameter pipe could not be adopted. The industry was delayed several years and vast sums of money were expended to compensate for the handicap imposed by the short-sighted standardization. Standardization thus must be farsighted and must progress with the development of the art if it is to assist instead of hinder normal development.

Standardization of radio receiving sets may be subdivided into the following classes:

Terminology.
Physical dimensions.
Constructional details.
Features involving operation.

Terminology is the language of an art and it is essential that new terms be accurately defined so that no one can misunderstand them. Frequently names are given to devices at the time they are invented which are unfortunate and which are either totally inadequate or totally misleading. The word "tickler," for instance, was given to the plate coil of a regenerative receiver by some Navy engineers shortly after the regenerative circuit was invented. No serious thought was expended in picking out a suitable name, but early investigators simply used the word colloquially, and, as is almost always the case, the name stuck in spite of frequent efforts to substitute some more suitable word.

Another Sign of Progress

Radio has changed in definite cycles since the time that the last word in wireless communication was a curious appearing device in a glass tube called a coherer. Although the industry has not nearly so much in common with the automobile industry as many Wise Ones would have us believe, a similar period of standardization in radio is coming and Mr. Allen's article analyzes the situation very sanely and helpfully, we think. The Associated Manufacturers of Electrical Supplies, Radio Section, in their meeting at Atlantic City in June, 1924, canvassed the entire situation and decided that radio was sufficiently developed so that certain necessary elements could be safely standardized, with vast benefits to all concerned. The Radio Corporation of America group has already adopted the color cord standards, as have many of the neutrodyne manufacturers. Standard batteries, plugs, and jacks are already available according to the specifications of the Standards Committee, of which Mr. Allen is a member.—The Editor.

WHAT TERMS SHALL WE USE?

IT IS thus evident that new terms incident to development in a new art should be suitable for the purpose and must mean one thing only. This does not mean that only one word must be used to name any part. It is well known that every flower has in addition to its common name a botanical name, and so devices in the radio art may have two names, if that seems desirable. For instance, the term "feed back control" may be changed to "amplification control," when the receiver is designed to be handled by the novice, providing that this term is consistently used in this way and is not used to describe any other part of the device.

The standardization of physical dimensions in a new art may be of two kinds; namely, specific and general.

Specific dimensions for radio apparatus must be standardized for such devices as are generally termed accessories. This includes telephone plugs and jacks, vacuum tubes, dry batteries, etc. Specific dimensions are the most difficult features of standardization of a new art. It is next to impossible for any one to stand at the threshold of development and foresee all of the possibilities of new devices, yet such standardization is essential to the progress of the art. Very seldom are the early standards permanent, and the general procedure is to adopt the most obvious standard, changing it as necessary, using adapters to accommodate the old standard to the new practice until the old has been completely superseded. This involves inconvenience and expense, of course, but greater expense would surely be involved through not having the courage to change standards when changes are obviously necessary.

Standard sizes for dry batteries are governed principally by the minimum size that will give a satisfactory life. The battery manufacturer determines the sizes. The manufacturer of the self-contained radio receiver must make his equipment to accommodate the batteries offered.

The general physical dimensions of radio receivers are determined partly by whatever sizes conveniently fit into the modern home and partly from the style of furniture prevailing. Cabinet receivers, complete with stand, are on the market in both upright and pedestal types. Table or console models are also popular.

Cabinet radio receivers designed to be supported on a table have their proportions, of course, determined by the proportions of available tables. Fig. 1 illustrates one of the vertical self-contained sets complete with a stand, and other cabinet receivers are suitable for mounting on a gate-leg table.

WHY CONSTRUCTIONAL DETAILS SHOULD BE STANDARDIZED

THE standardization of constructional details is important both from the standpoint of the manufacturer and the user. The use of a universal type of connector for flexible cord terminals, for instance, is desirable to the manufacturer because all manufacturers can purchase these parts in large quantities from the same outside manufacturers with corresponding reduction in price.

The user prefers such a type of terminal because he can connect such a terminal to any type of battery. Likewise the standardization of markings is a great step forward in reducing ambiguity and confusion particularly in sets that are sold, ready to be assembled.

By the standardization of features involving operation is meant the arrangement of knobs, binding posts, tubes, etc. In the cabinet set, it further means the arrangement of batteries and especially battery connections.

Except for the work done by the Bureau of Steam Engineering of the U. S. Navy, the first real step in standardization was taken during the past year by the Radio Section of the Associated Manufacturers of Electrical Supplies. An immeasurable amount of credit is due this organization for the courage and foresight that has been shown and equal credit is due the manufacturer members for the unselfish way in which they have subscribed to the standards of the Association. True, only a start has been made, but even in the past short year, the work that has been accomplished will have far-reaching effect both for the manufacturer and the user of radio receivers.

One of the outstanding results of the year's work that is of particular interest to the user is the standardization of color markings for cord connections to radio receivers. With the modern trend toward the convenient flexible cords for connections to batteries instead of the older type binding posts, some automatic method of insuring correct connections even if the instruction book be lost becomes essential. The colors adopted by the Association are shown on the color plate on page 1034.

RADIO CORDS ARE TO BE STANDARD

A STUDY of the chart will disclose the fact that a very definite plan has been followed which is almost self-explanatory.

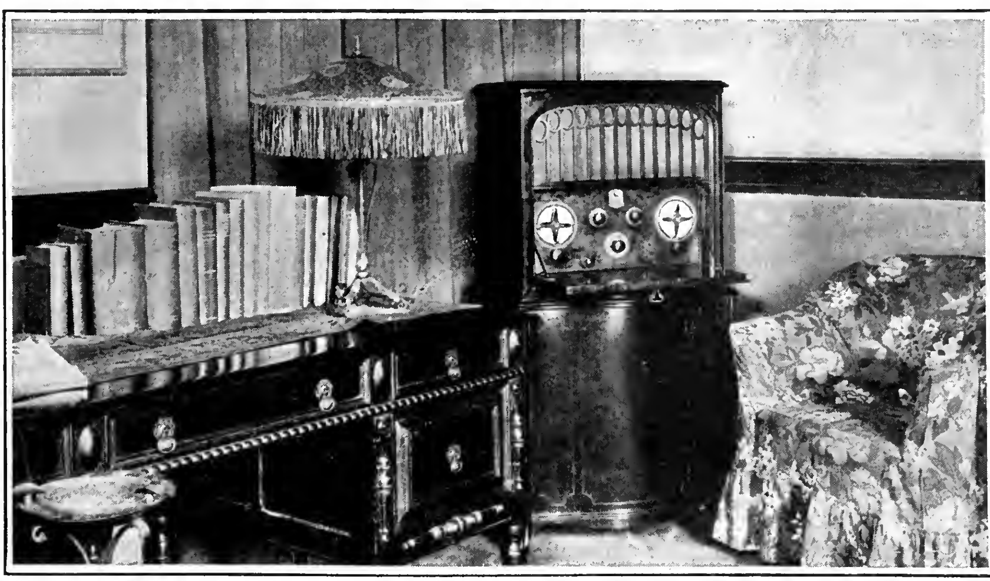


FIG. 1

A standard receiver of a popular type. The batteries, antenna, etc., are all contained in the cabinet. In order for set manufacturers and battery manufacturers to supply parts which will fit into any receiver of similar type, standardization of supplies is essential

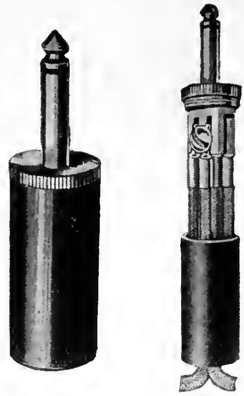


FIG. 2

A type of plug made according to the specifications of the Standards Committee of the Associated Manufacturers of Electrical Supplies. The plan of the Committee is that any plug sold will fit into any jack available. With very few exceptions these standards have already been put in force by manufacturers of these parts

Blue is used to designate the antenna circuit, due to the fact that the antenna is always associated with height and the blue sky. Yellow is used for the filament circuit to suggest the color at which the filaments operate. Bright red was used to designate the highest positive B battery potential, this being conventional electrical engineering practice. Maroon, a less bright red, is used to designate one of the lower voltage positive leads. Black is used for ground and in all places where another color is now required.

These colors are solid colors. In the case of the low side (negative) of circuits, a tracer of the proper color to designate the circuit is used instead of a solid color. Thus, the negative side of the filament circuit uses a black cord with a yellow tracer.

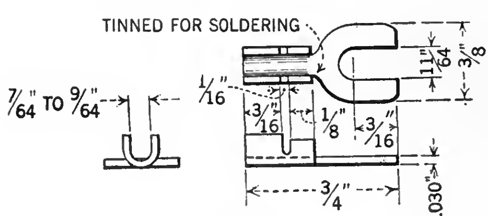


FIG. 3
The standard lug

Where one cord does double duty, such as when the negative B battery cord also serves as the negative A battery cord, the cotton covering is red with a yellow tracer.

While these color designations are primarily intended for connections to factory-made sets, there is nothing to prevent the builder of home-made sets adopting such a color scheme for internal wiring. Every constructor will at once recognize the value of standard color cords in connecting receivers he builds. Hours of time can be saved. As soon as these color markings are published, colored spaghetti and covered bus wire will undoubtedly make its appearance. The circuits of a set built in this way will be infinitely easier to trace than if the set was wired using wire of all one color.

Some of the specific dimension standards are of general interest. The terminal lug shown in Fig. 3 has been adopted for battery connections by the Association. This terminal will fit the standard thumb-screw battery post and will also fit any of the spring battery terminals. Any one who has attempted to connect B batteries with spring connectors to some of the terminals on the market will appreciate the value of such a standardized lug.

The dimensions of telephone plugs and jacks have been standardized so that any make of plug will fit any make of jack. These standardized sizes are shown in Fig. 4.

STANDARD B BATTERIES

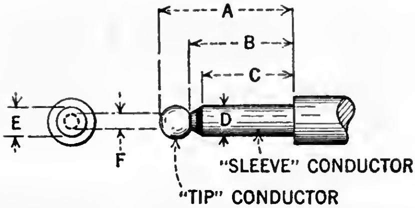
B-BATTERY dimensions have been standardized and the size of battery for different current drains has been specified. The following designating letters refer to batteries using the individual standard size cells shown:

DESIGNATION	INDIVIDUAL CELL DIMENSIONS
A	$\frac{5}{8} \times 1\frac{7}{8}$
B	$\frac{3}{4} \times 2\frac{1}{8}$
C	$\frac{15}{16} \times 1\frac{13}{16}$
D	$1\frac{1}{4} \times 2\frac{1}{4}$
E	$1\frac{1}{4} \times 2\frac{7}{8}$
F	$1\frac{1}{4} \times 3\frac{7}{16}$

In addition to these letter designations, the letter H is used to indicate the horizontal type of radio battery and V to indicate vertical type of battery.

The complete designating data for a battery also includes the number of cells. Thus the Eveready battery No. 766 and Burgess No. 2156 will be known as H-15-D, meaning a horizontal battery of 15 D size cells.

The Radio Apparatus Section of the Associated Manufacturers of Electrical Supplies has specified that for portable sets the B or C size cells are to be used. For non-portable



DIMENSION	MINIMUM	TOLERANCE	MAXIMUM
A	1.179"	.020"	1.199"
B	-	-	.959"
C	-	-	.863"
D	.248"	.002"	.250"
E	.243"	.002"	.245"
F	3/16"		

FIG. 4

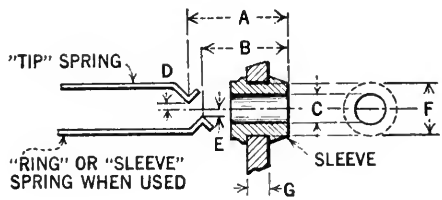
The standard plug for radio use and the complete specifications of the Standards Committee of the A. M. E. S.

receivers the D size cells are to be used for current drains not exceeding 15 milliamperes and for the highest current drains, the F size cell is to be used.

In addition to these specific standard dimensions, the Section has adopted standards of practice for manufacturers which will make for improved quality of apparatus and for greater convenience in handling. For instance, it has been decided that the sleeve of the telephone plug shall in every case be made positive. This is an important feature for loud speakers used outside the receiver, as some types of loud speakers are particularly sensitive to the direction of current flowing to the B battery.

American Society of Mechanical Engineers standard screws have been adopted, which will facilitate repairs and knob-markings have been standardized. The diameters of shafts on which knobs are used have been definitely specified. The maximum and minimum impedance of loud speaker and telephone receivers are stated. Electrical tests have been planned and many other standards have been laid down by the Section which will operate to increase the convenience of operating standardized receivers, and will, furthermore, make for a better and cheaper product that can be more easily maintained at a decreased cost.

While it is true that much yet remains to be done in the standardization of radio receivers, it is felt that a very decided start has been made and there is no doubt but that as the art progresses, standardization by reputable manufacturers, through their representative organization, the Associated Manufacturers of Electrical Supplies, will continue to keep abreast of the times which will eventually result in vast benefits to the user.



DIMENSION	MINIMUM	TOLERANCE	MAXIMUM
A	1.000 "	.040 "	1.040 "
B	.770 "	.020 "	.790 "
C	.2515"	.0015"	.2530"
D	.020 "	.010 "	.030 "
E	.030 "	.010 "	.040 "
F	-	-	.450"
G	1/8"	-	1/4"

FIG. 5

Specifications and dimensions for the standard jack

NEW TRENDS IN BROADCASTING

THERE is a definitely new departure lately manifest in broadcasting programs which has appeared in the form of the so-called "Hours." Some of these have been devoted entirely to music, others are partly musical and partly dramatic, and so on. How this development came about and how these programs are planned are described in one of James C. Young's interesting articles which will be a feature of an early number of RADIO BROADCAST. The broadcast listener who is interested in seeing the manufacture of a program from the very real "inside" will enjoy Mr. Young's story.

Can We Solve the Broadcast Riddle?

A Consideration of the Prize Plans in Radio Broadcast's $500 Contest—Is the Winning Plan Feasible?—Some Thoughts on the Economics of Broadcasting

By ZEH BOUCK

THERE were about eight hundred plans submitted in the recent contest conducted by Radio Broadcast in which a prize of $500 was offered for the best answer to the question: "Who Is to Pay for Broadcasting—and How?" It was my pleasure, as one of the judges, to read over all the plans which were considered. It was very gratifying to find so representative a portion of the radio audience exhibiting a sincere interest in the economics of broadcasting. The variety of the solutions showed that considerable intelligent thought had been devoted to the problem.

All of the ideas possess workable possibilities and in many cases the ingenuity of the plan compensates for the absence of more practical qualities. Among the especially ingenious schemes were two based on the possibility of capitalizing the necessity for printed radio programs. One idea was to syndicate these programs to the daily press throughout the country at a nominal rate which nevertheless would agglomerate into a respectable sum. The second arrangement advocates the printing of radio programs as an individual publication, prohibiting, through copyright, any duplication in the press. Radio listeners would therefore be compelled to pay for their programs, buying them on the news stands or through subscriptions. A bit of interesting and relevant text might be worked into the programs. It will not be surprising if, to-morrow, we find this scheme oiling the cogs of radio's economic machinery.

Another idea was that the Government license all receiving sets. This system is working in several European countries. But regardless of its success across the water, which is wide open to doubt, it could only fail here. Fundamentally no government is capable of supervising a highly technical utility (as Professor Pupin has observed), and the idea is too autocratic to be palatable to Yankee tastes. For the same reasons, a third suggestion of complete government control, with taxation in proportion to the ability of the set to receive distance, must be abandoned.

Another ingenious idea provides for a gigantic drive, concentrated into a period of thirty days in which voluntary contributions would be solicited from rich and poor enthusiasts. The resulting sum, high up in million-dollar optimism, would form a trust fund which should support wireless broadcasting for the rest of its days. Aside from making up, in part, to posterity for the ills we are bequeathing it, little else recommends this idea.

In these plans, and many more, we find the main idea.

The essence of the whole contest is that ultimately the listeners must pay for their

"Admission Free"

A certain acute sense of what is "good business" in Americans makes them particularly curious about the future of broadcasting, because it seems to be coming to their studies and their living rooms night after night with no charge attached. Obviously, broadcasting has a definite invisible "means of support," but there is very general uncertainty among those who have given the subject thought whether this situation is ethically right. Zeh Bouck was one of the judges in the recent contest conducted by this magazine to find the best suggested solution for the "Who's to Pay" problem. In this article, the author reviews the main points of the other submitted plans which were considered and adds many conclusions of his own which throw not a little light on the subject. The last word has certainly not been said on this subject, but the only way to get nearer the real solution is to discuss all angles of the problem thoroughly.—The Editor.

aërial pleasures, and that such a payment is not only fair and just, but will add tremendously to the pleasurable possibilities of radio.

THE WINNING PLAN

AS TO the manner in which this happy situation is to be achieved, the winning plan of Mr. Kellogg is probably the most enlightening. Certainly, did it not possess considerable merit it would not have won. Thus, if we strip from it a few superficial incompatibilities, we should have a creditable backbone—well integrated and sturdy vertibræ—capable of sustaining the weight of problems associated with its materialization. This, indeed, we shall find, and also that the idea has not dawned solely upon Mr. Kellogg, but upon other minds more intimately associated with radio.

The plan, in brief, (RADIO BROADCAST for March, page 863) advocates a federal stamp tax on crystals and tubes, with revenues distributed to the various broadcasting stations by the Government.

WHY NOT EXTEND THE TAX?

OUR first doubt, in order of mention, is the limitation of Mr. Kellogg's tax. If the tax is confined only to crystals and tubes it will boost the prices of these commodities, particularly of tubes, far above their present high levels. Mr. Kellogg recommends a two-dollar tax on vacuum tubes. Simple addition then determines the ultimate price of vacuum tubes at five dollars each. This would undoubtedly discourage the use of multi-tube receivers, with an automatic reduction in revenue to those concerned with revenue, and perhaps seriously hamper the progress of popular wireless. Moreover, this system does not place the burden of taxation where it belongs. In almost all of the suggested plans, too much emphasis has been given to the specious desirability of taxing in proportion to the amusement or benefits derived from the purchased material. Enjoyment is entirely relative and individual, and varies in no arbitrary ratio to the amount of money spent upon it. It is probable that

SIMILAR OPINIONS

Are held by Professor J. H. Morecroft, left, past president of the Institute of Radio Engineers and author of *The Principles of Radio Communication*, and John V. L. Hogan also a past president of the I. R. E. and a consulting radio engineer. Mr. Hogan wrote *The Outline of Radio*. Says Professor Morecroft about the prize-winning plan: "I do not see how a fund collected from the taxing measure can be equitably distributed. I dislike the idea of the Government getting into the game because of its well-known and frequently proved inefficiency and blighting effect in attempting to carry on a technical enterprise. Let us keep broadcasting as far as possible out of Government hands." And Mr. Hogan wrote: "I see no real objection to a voluntary tax on tubes and crystals, but I feel that the real difficulty would lie in distributing the funds so raised. I do not believe the Government would be willing to accept the responsibility for such distribution, and, even were it willing, I feel quite strongly that governmental supervision of the program treasury would not please either the radio listeners or the radio industry"

the impecunious fellow in the hall bedroom derives more amusement and utility from his three-tube set, than does the millionaire listening in occasionally on his thousand-dollar installation.

A tax limited to tubes and crystals would impose an equal rate upon the purchaser of a five-hundred-dollar console and the chap who has scraped together sixty dollars for a simply made five-tube receiver.

To levy an ad valorem duty on all parts and complete sets is obviously a more equitable system of taxation. This would slash the necessary tax to a fraction of the sixty-six and two thirds per cent. addition recommended by Mr. Kellogg on tubes, and would impose itself *in a proportion closely commensurate with the buyer's ability to afford it.* It has been estimated that radio of the tomorrow, no farther ahead, perhaps than 1926, can be adequately supported by a one per cent. tax on all equipment. The millionaire will then pay $505.00 for his sumptuous receiver, while the less pretentious five-tube set will retail for $60.00.

A sliding scale might be desirable, the rate of tax increasing with the value of the apparatus somewhat after the manner of our present income tax arrangements. Thus the suggested rate might apply to all goods under fifty dollars, two per cent. between fifty and one hundred dollars, three per cent. between one hundred and two hundred dollars, and so on.

Our first change then, in Mr. Kellogg's plan, would be to extend a reduced tax to all goods intimately associated with radio, the stamps to be applied to the manufactured article at the final factory. The imposition of such a duty is quite as simple a matter as the limited stamp act proposed in the winning plan.

GOVERNMENTAL CONTROL

AGAIN we must make objection to the governmental finger in the pie. Mr. Kellogg, in his plan, argues that this is most desirable in the following manner:

"The tremendous value to the Government of continuously having broadcasting stations under its control to crystallize and direct public opinion cannot be over-emphasized." This possibility about which Mr. Kellogg is so enthusiastic is the very thing that should be avoided as far as possible, and it is a consideration of even greater importance than federal incompetency in handling technical matters. It is the writer's opinion that the educational possibilities of radio broadcasting are the most potent of all known systems of teaching. This is because it insinuates itself to you in your home, in your receptive leisure moments. It teaches, insidiously, unfelt and pleasantly, which is how things truly learned are always learned. To place wireless under a more strict governmental supervision would be to hamper a great educator. The idea is comparable, but more iniquitous, with placing every school in the United States under direct Federal supervision.

The Government must never be permitted to direct and mold public opinion. On the contrary, *public opinion should mold and direct the government.* This is not socialism, anarchy, or Bolshevism. It is merely progress, and well-developed democracy if you will. The Government is already capable of protecting itself to a legitimate extent through its licensing of stations and the powerful cancellation prerogative. Anything more than this would tend to atrophy original thought in almost every branch of art and science, perhaps culminating in an odious censorship comparable to that we are told now exists in Russia.

What Authorities Think . . .

HERBERT HOOVER, Secretary of Commerce: "I do not believe that your prize-winning plan is feasible under conditions as they exist in this country, however well it may work elsewhere."

MICHAEL PUPIN, Engineer, Educator, and Inventor: "Railroads, telegraphy, telephony, radio broadcasting . . . are certainly public utilities. . . . All of these public utilities are full of complex technical problems which cannot and never were intended to be handled by any government."

PAUL B. KLUGH, Executive Chairman, National Association of Broadcasters: "A Government tax would be obnoxious. For obvious reasons, voluntary contributions offer only an unfair solution. The rain would fall equally on the just and unjust. This leaves the possibility of a non-federal stamp tax, which seems to hold most promise of satisfaction for all parties concerned."

THE ALTERNATIVE

IF WE eliminate governmental control what may we substitute for it? The only logical thing that comes to mind is an organization composed of broadcasters and manufacturers who will impose and collect a stamp tax (the simplest form of excise), and distribute the funds in an equitable manner. The only

argument in favor of a government-controlled air is the desirable central authority of a federal act. The facilities such an act would confer for enforcing whatever tax measure the legislature should deem wise and fit, would greatly simplify the whole matter. But it should not be difficult for a highly representative organization to develop executive powers, quite comparable (if not actually greater), than to those of national authority. The organization must necessarily be a representative one, and the manufacturers affiliated with it—the soundest and most reputable in the country—would need only decline to deal with such retailers who handle bootleg or unstamped apparatus to bring them around. To obviate partiality and the possibility of corruption, the committee in charge of collection and appropriation would be composed largely of commercially disinterested individuals such as J. P. Morgan, Robert W. De Forest, George Gordon Battle, or many others who might be willing and qualified to serve.

Perhaps Mr. Kellogg, who characterized such an arrangement as "inconceivable," will be inclined to alter his opinion upon the above analysis. Its practicability is such that it suggested itself to the National Association of Broadcasters, an organization closely comparable to that we have outlined, and of which Paul B. Klugh is Executive Chairman. The Committee On Paid Programs, authorized by this organization, evolved a system almost identically similar to that suggested above. The feasibility of this proposal is emphasized by the general satisfaction it would give.

The public would receive better service, the best possible programs with the additional satisfaction of a direct deal between the listener and the artist.

The artist would be satisfied for obvious reasons.

The broadcaster certainly would not complain, for his expenses would not only be reduced, but in many cases his station turned into a profitable proposition.

FRANK REICHMANN

Of Chicago. He is a well-known radio manufacturer and engineer and was one of the judges in the contest recently conducted by this magazine

THE DISTRIBUTION PROBLEM

RADIO, were this suggestion adopted, would become still more popular, with an appreciable and welcome benefit to the manufacturers, jobbers, retailers, and all concerned.

The equitable distribution of the collected funds is the real and acknowledged rub. The sands which must necessarily support the foundation of any radio economic system are to-day shifting, if not actually sliding. The permanence and desirability of radio advertising have not been established. Radio advertising rates have not as yet adjusted themselves, as they must, to a sum commensurate with the value of the publicity, nor has the amount of advertising permissible in a single program been determined upon. The hundreds of stations, small and large, whose economic status, is doubtful, plus many other factors, lend their weight to the general lack of equilibrium of the radio industry.

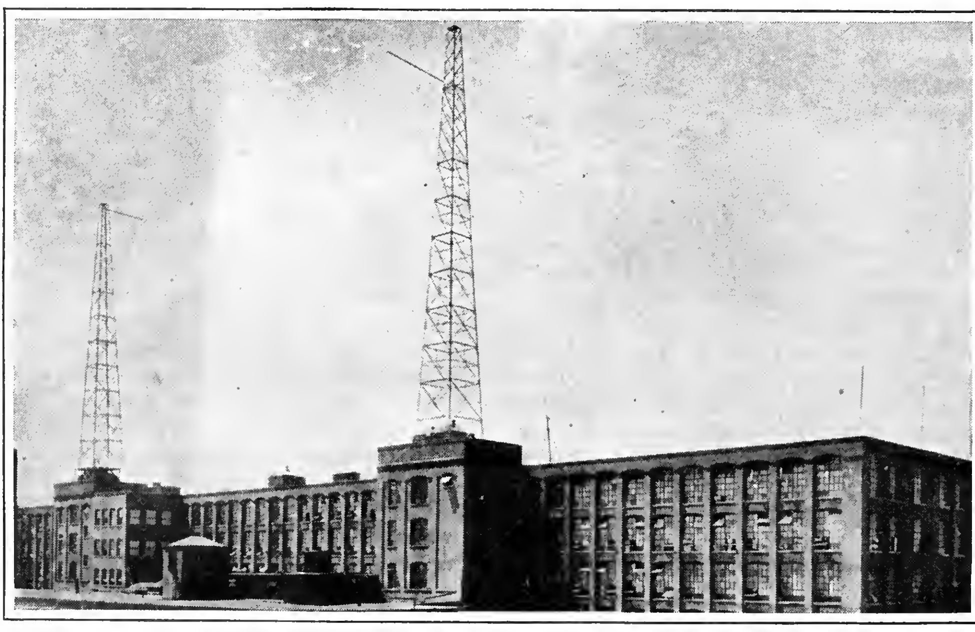
Radio is in a chaotic halfway stage. It is *not* in its infancy, but it is only in the early process of development. Super-power, the interlinking of stations and other experiments are just emerging from mental and engineering laboratories, and all these inchoate developments, these budding possibilities, must vitally affect the mechanics of paying for broadcasting.

ARE WE READY?

PAUL B. KLUGH, in reference to the activity of his own organization, has described the movement as premature. I believe he is right. For the present, I think it is better to let things ride along as they are. To work these excellent plans into a more mandatory proposition, to make a law of this plan and endeavor to apply it, would be forcing the issue. Such a procedure is rarely wise or successful. To be successful and permanent—a proposition must *force itself* upon the situation as a necessity, whether or not far-sighted individuals appreciated the desirability many years before.

Herbert Hoover has said, "If we are once agreed that broadcasting really has a mission [who doubts it?] it follows that it must and will work out its own financial basis." Exactly so. And in concluding we desire to point out that, in all probability, the resulting scheme of things will be closely similar to the plans proposed to-day.

The taste of the fan is rapidly being educated. His innate desire f r what is good is being gratified, and he has learned to expect the best in programs which have been steadily improving. Retrogradation is inconceivable. All large broadcasters indubitably will continue to improve their programs. The increased expenses concurrent with this consistent improvement can only be met by the broadcasting manufacturers, through an increase in the selling price of their products: complete sets, tubes, loud speakers, storage batteries, etc., or by a refusal to lower prices when it could be otherwise possible for them to do so. Other radio manufacturers who do not support broadcasting stations—a grand and glorious host of comparatively small corporations—will therefore be able to undersell the larger companies. It will be then (or perhaps before the situation becomes acute) that these great organizations will be forced to protect their own interests, either by confederating among themselves, or, as would be more palatable to the public, lending their coöperative support to some recognized non-commercial radio body. In this, the reader will recognize the principal recommendation discussed in these pages. A stamp tax imposed by such a federation seems the least complex method of adjusting a very difficult and involved situation so that it may be within the boundaries of fair competition.



THE TOWERS OF WBZ

At Springfield, Massachusetts. This is one of the stations heard abroad during the recent Radio Broadcast International Tests

How to Write a Radio Play

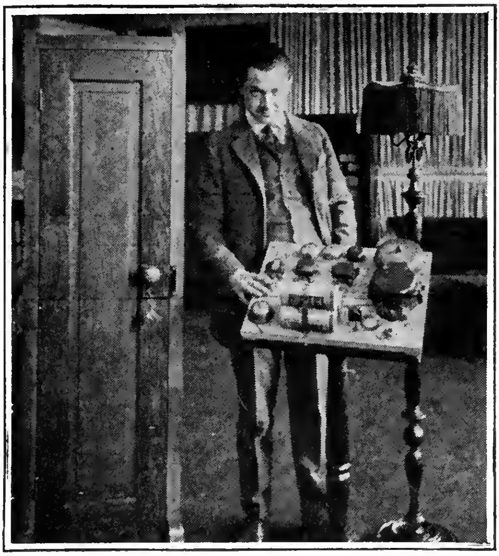
by MILDRED WEINBERGER

A "RADIO PLAY"—what is it? Simply a play, comedy, tragedy, or what not, written directly for broadcasting. Its definition thus depends wholly on its purpose. A play which is primarily a radio play may, of course, be perfectly adaptable for presentation on the boards, the so-called "legitimate" theatre, inasmuch as the differences between these two are not such as to make them mutually exclusive. It is the special play written for the microphone and received on radio sets in a multitude of homes, that we are going to discuss.

The question naturally arises, why should there be a special radio play? Legitimate plays have been broadcast before now, some of them with marked success. It is true that the number of plays open to choice for broadcasting is necessarily limited, and the whole number of plays large. Only certain types of play are effective when so given, and only certain plays are sufficiently free of copyright and other strictures, to be available. The whole question of broadcasting plays, which is agitating some of our theatre managers at present, might be answered by keeping the two fields largely separate. Thus a play which is running on Broadway may not, be broadcast, if the manager considers that his seat sale would be jeopardized. The program department of a radio station would not even be tempted to request to broadcast the play if there were plenty of other material to choose from. But the radio audience *does* like plays.

Statistics Show

That one person out of every six has written a play at some time in his life. The statistics don't have much to say about the number of these plays actually produced, however. And since radio drama has lately been included on an increasing number of programs from an increasing number of stations, it is perfectly obvious that the plays must come from somewhere. There is no question about the fact that a lot of budding radio-play talent is hiding its light under various rural and municipal bushels. It is possible that a number of Ambitious Ones have even submitted radio plays to program directors before now—certainly they did in a contest held last year by a large eastern station. Mildred Weinberger has set down here a lot of information about radio plays and how they should be written which should be of great help to the budding playwright and of interest to those of the radio audience who listen to radio plays. Radio program managers might be interested in developing good radio plays for their programs and a contest or two would probably draw forth some very good work.—THE EDITOR.



A FEW PROPERTIES FOR THE RADIO DRAMA

A portable door which can be opened and shut to indicate entrances and exits of characters. The bells on the stand give any effect from that of an ambulance to the thin chime of a clock. Edward H. Smith, director of the WGY players at Schenectady is shown in the photograph

To write a play for broadcasting one must remember that your play "gets over" through the ear alone. There will be no costumes, settings, make-up, or properties to assist in putting it across. Simple settings, costumes, and properties can be described by the radio announcer. Many interruptions of the action of the play, for interpolated directions, weaken its effect. Therefore, we have a list of things to do, and another of things *not* to do in writing a play for radio broadcasting.

WHAT TO DO

WHAT are the *positive* requirements to make our radio play effective? First, keep the cast simple. Have only a *few* characters, so that your audience will not forget them and be confused as to which one is speaking. Then, when you name your people, use names which are clear in sound. Remember how some names are easy to get over the telephone, and others have to be repeated five or six times before you understand who is speaking. If you are blessed with one of those difficult names, and call up a department store, or telephone a telegram, you will know all about that! Your patience is gone before the matter is even comprehended at the other end. So call your people by names which come clearly to the ear. Then, too, each name mt be distinct from every other one. "Sue," d "Prue," would not be a good choice for o women characters in the same play. Wen you can *see* who is speaking there is no dbt in the matter, but our radio audience cdistinguish only by its ears. A crowd isever useful in a broadcast play, unless yo wish merely an effect of confusion. If the ea is to represent a background of convertion, it can be done very well, with perha two voices, those of important characters, ming out of it. One must be careful not to ri confusion in the lines of important characte. If three or more people try to talk a once even at very close intervals, so as to ge an effect of eagerness, excitement, or wha not, the author of a radio play runs a strong cance of merely blurring the speeches. In aadio play, the speech and the speaker shod at all times be easily recognized by the sunds going out.

It might be helpful, also, to use the nae of the character addressed, more often tha necessary in a stage play. For example Joe and Harry meet

JOE. Well, Harry, how's the boy?

HARRY. First rate, Joe. How's the world reating you?

JOE. Oh, so so. I've had a pretty raw dea from Mamie. Did you hear?

HARRY. Why no, Joe. That's too bad——

The hearer is never in doubt about hich radio character is speaking. Of course the actors in a radio play will be selected pincipally for their voices, so that the voice ofeach

THE KISS—BY RADIO

The personal touch, it is obvious, is quite lacking. The scene was snapped in the studio of KGO, at Oakland, California

character is recognized as distinct from every other one. But it never hurts to make assurance doubly sure. Without the use of the eye some of us are surprisingly helpless. Have you ever noticed how comparatively few people can recognize which of their friends is talking over the telephone?

GOOD WORDS FOR RADIO

THEN there is the question of the actual words of your speeches. Use simple and direct English. Make the speeches short enough to be comprehended at one hearing.

Do not use dialect which is often difficult to follow, even where the speaker is visible, and over the telephone it is very confusing. That means eliminate the humorous Irish brogue, the colored mammy, the Scotch, and various other tempting type parts. Also, it is better judgment and better taste not to use slang, or the curtailed and often grossly incorrect English of the "pedestrian." Good English can be learned through the theatre, as many Settlement dramatic organizations will affirm. The radio program is especially effective in this field because it comes so directly into the home, and because it has so many young listeners, many of whom like to be in style with the latest colloquialisms, at the expense of a real knowledge of their own language.

When it comes to the story of the play, give enough in the actual words of your speeches so that the physical activity of the characters is clear. If one man were trying to get something from another, for instance, he might say, "Give that to me, or I will tear it from you." The answer is, "Over my dead body!" A third voice cries—a woman's—"Don't fight! Oh, you are hurting him!" The first man exclaims, "I have it." Now we know what has taken place, without seeing a thing. There can, of course, be simple sounds, put in by the "property man," such as the shutting of a door, a pistol shot, a bell ringing, the thump of a falling body. The simplest and clearest of these actions can be explained by words in a radio play without being redundant. In general, words must take the place of what would be pantomime in a stage play. This leads to an interesting development—the use of the soliloquy, which has been out of date in the legitimate drama for several decades.

The soliloquy must represent in the radio play what an actor is feeling, where he

CONTRAST

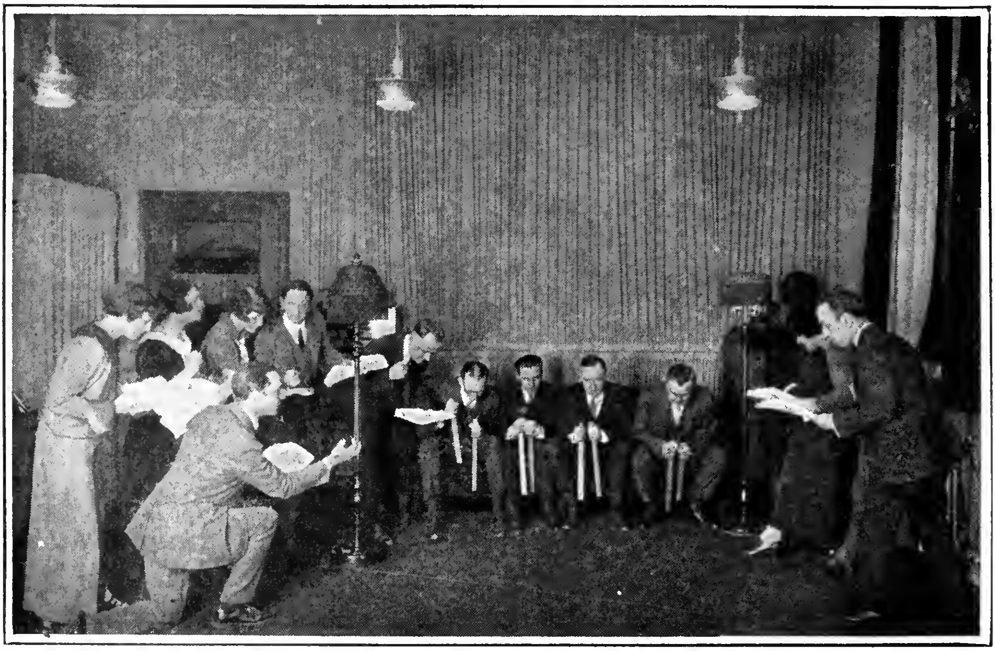
This photograph shows how a love scene would be enacted on the stage and the cut which forms the heading of this article shows how a love scene was broadcast recently from WGY. There, the two outside players are involved and the actors in the center are awaiting their cues

could show this to his audience by the working of his face, his hands, his general movements, if our eyes could see him. Still we are out of patience with the long soliloquy, which is merely a stilted recitation. When a man talks to himself, it should therefore be natural, natural in the play and in the character. People who are much alone often do talk to themselves. Under the stress of emotion any one may exclaim aloud, and so the cases multiply. But the soliloquy in the radio play must serve a double purpose. It must continue the action, audibly, while any character is "on the stage" alone. We must hear what he is doing.

It would seem besides all this, as though the radio play especially ought to be kept at a constant pitch of emotion—that is, the characters should be highly involved, emotionally, as much of the time as possible. There is something very effective in the quiet spaces of a stage play, filled with color, light, dramatic pauses, when our eyes are taken with the picture and our interest held. But not so in the broadcast play. We cannot see. This fact cannot be too much emphasized, because it is at the root of the whole difference between the radio pool and any other sort. Our interest has but one medium to sustain it here. If we are bored, we retune the radio set and pick up some other station. The radio playwright can only hold his audience by sustaining constantly the movement, the emotion, of the story in the play. And all of this has to go into the speeches—the words of the actors.

RADIO PLAYS SHOULD BE SHORT

IT IS advisable to make the radio play short and so avoid tiring the audience. This opens delightful fields for the playwright. Try to interest a Broadway manager in a play which runs less than two hours! Try to make him consider even a two-act play! Yet here in the broadcasting of plays, we are free. Why not write that two-act play which has been bothering you this long while, and try it on the radio? There are many delightful situations which naturally fall into just this division of time or place, but, unfortunately, we know they will have no Broadway market in the two-act form. So we try to fatten them, and spread them, and pull them out of proportion, much to our own grief, and theirs. Another delightful prospect is that of freedom in the choice of setting. The most fantastic, the most extravagant set that the imagination can devise, is nothing to the disadvantage of your play. All you have to do is describe it—in words—and the announcer in the radio station will read them and create the scene. There



"THE COUNTRY FAIR"

In the process of broadcasting in the studio of WGY. The four on the divan are really horses, ready to race. In recent months, radio plays have become increasingly popular in almost every section of the country

"PIERRE OF THE PLAINS"

A melodrama, recently produced at WGY. One of the prime essentials of this new art is that the number of characters be few, and their speeches informative and direct. The radio drama has no limitations as to place, for it is just as easy to hold one act in Central America and the next in Iceland as it is to have both before a log fire in a London Club

should then be a field, here, for many a good play which offers obstacles to a Broadway production.

THE STAGE VS. THE BROADCASTING STUDIO

THE apparent rivalry between the stage play and radio broadcasting seems, on these grounds, not so formidable. As a matter of fact, many a play which is scoring a great success in the theatre would not be good, at all, sent out from a radio station. Take "What Price Glory," a most stirring experience on the regular stage. What would the second act be, if we could only *hear* it? Take away the dugout, the dim light, the make-up of the men and you have a series of disjointed recitations, with all that grim significance gone. And the last act wouldn't be there at all. But how tremendously it *is* there, at the Plymouth Theatre! Conversely, however, the fact that a play is effective on a radio program does not prohibit its stage success. Perhaps it has never had a hearing, and what better hearing could it possibly have than this, to be broadcast far and wide?

It should be very possible to rewrite many plays, originally intended for stage production so that they will suit the peculiar demands of broadcasting very well. It has been suggested that a moving picture scenario offers greater possibilities, but this does not seem likely. The moving picture appeals to the eye almost as exclusively as the radio play reaches the ear. It is written in terms of pantomime, which is the very thing impossible to represent over a studio microphone. Its story is based on physical action, and the possibility of effective visual drama. The radio play must make its pictures audible. Everything needful to the furtherance of the story must be told in the lines. Thus only slight changes or additions to an existing stage play might make it a good radio vehicle, while rewriting the story of a movie would mean writing a whole new play.

Why, in any case, borrow from preëxisting fields, when new horizons open? Why not create a body of dramatic literature primarily intended for this specific purpose, the radio play?

The Listeners' Point of View
Conducted by Jennie Irene Mix

Opinions About the Jazz Age in Radio

OF LATE some of the saxophone specialists and some of the leaders of jazz orchestras heard over the radio have risen up in wrath, and in letters couched in unmistakable terms, have accused the conductor of this department of trying to put all the jazz players in the country out of their jobs, and especially to condemn every saxophone player to eternal obscurity.

It has been interesting to receive these letters. Adverse criticism as well as laudatory criticism can be a tonic. But to be a tonic it must strike with truth at the core of the subject criticised. In this, every letter so far received protesting against this department's attitude toward the broadcasting of jazz, has failed to make its point. For every letter has brought the accusation that we have unremittedly condemned, wholesale, all jazz and all jazz players.

Now, first let it be said that the conductor of this department does not especially enjoy jazz. If it is so-called "artistic jazz" about all you get out of it is to listen to distortions of the masterpieces of music, the great operatic arias, the immortal songs. If it is the sort of jazz that plays the latest popular hits it is pretty nearly unspeakable, in our opinion.

Although not an admirer of any sort of jazz, it would be far from consistent or fair for us to make a sweeping condemnation of this form of music. By certain jazz specialists it has been raised to what is, of its kind, an art. If it is the sort of art you enjoy, it is your full right to hear as much of it as you desire. If you don't enjoy it, yours is the privilege to say so.

Here is a list of the jazz orchestras that have received "Honorable Mention" in this department since it opened in April, 1924. In every instance a photograph of the organization mentioned was published.

Vincent Lopez and his Hotel Pennsylvania Orchestra.

Harvey Marburger and his Keith Vaudeville Entertainers, Café L'Aiglon, Philadelphia.

The Campus Serenaders of the Rensselaer Polytechnic School, Troy, New York.

Perry & Russell, "Two-Man Singing Orchestra."

Paul Specht's Hotel Alamac Orchestra, New York.

Also was published a photograph of William Menzer and his "Musical Saw." We confess that the Musical Saw has a weird and haunting fascination for us. And as for the steel guitars, they stand high, in our regard, as radio entertainers. Have you noticed what good music you hear when they are programmed? They produce music played, generally, with fine taste. Indeed, there are precious few violinists heard over the radio who can come within sight of these guitar players in musical taste or technical achievement.

It is not against legitimate jazz or any of the musical features that cannot be ranked as "classical" and yet are good, that this department is fighting. What we are out to kill completely and forever is the sort of broadcasting described in masterly fashion by Dr. R. S. Minerd of Erie, Pennsylvania, who, writes, in a letter recently received from him, after uttering a hearty Amen to all that has been said in this department against radio programs:

Night after night, when I get home after a hard, long day, I don't feel like tuning-in and tuning-out half a dozen stations, each of which inquires in squally, squeaky, uncanny,"saxofool" wails," What's Become of Sally?" Who, of all the millions of musi-

cians and musically inclined listeners-in in the world ever cares a hang where that fool Sally is or anything else about her except to regret that hers was not a still-birth! Or who's going to "Follow the Swallow" to find "Where's My Sweetie Hiding?" And "Red Hot Mama" is such a beautifully endearing term to screech into the ear of one whose tenderest memories are those of "Mother"!

I have tuned-in the same station several times each evening, only to hear that someone has just wired or phoned a request for another repetition of one of these soulless assemblages of noise which had already been "played" several times the same evening.

The radio audience certainly is *not* composed wholly of morons. There are, perhaps, as large a number of those who appreciate music as there are persons whose musical appreciation wallows in the depths of the muck and mire, and it is an outrage that stations which are trying to broadcast music must realize that their efforts come to naught because some near high-powered station persists in profaning the very air with their senseless confusion. . . . I am expressing the feelings of a host of radio enthusiasts among my friends when I say what I have said.

Dr. Minerd does not by a word exaggerate the condition that prevails, a few stations excepted, all over the country from about 10 P. M. to 2 A. M.

Where does the fault lie? Well, all will agree that the programs from a broadcasting station cannot rise higher than the intelligence of the program director.

The remedy? It can be found only in the owners of broadcasting stations. When they see to it that their stations are run intelligently we shall have programs that can command our respect, but not until then.

It is the public that must make the owners of broadcasting stations see that they are playing a losing game. And this can be done only by putting up a loud and never-ending protest against present conditions. Judging from the letters that come to this department this protest will soon gain such momentum and volume as to cause a sudden and devastating explosion somewhere.

Interesting Sidelights on the Flonzaley Quartet

WHEN the Flonzaley Quartet broadcast from station WEAF in the third of the Victor Talking Machine radio programs, no doubt many said:

"Isn't it simply fine that this great string quartet can be heard by thousands of people in the small cities and towns? I don't suppose they can appreciate them on a first hearing, but then, they can buy records of the numbers they hear to-night."

THE STUDIO OF KOA, AT DENVER

A group of artists broadcasting from the main studio of the new station of the General Electric Company, KOA, at Denver. A pity the performers couldn't be seen as well as heard!

THE FLONZALEY QUARTET
From left to right, Adolfo Betti, first violin; Alfred Pochon, second violin; Iwan d'Archambeau, violoncello; Félicien d'Archambeau, viola

Now, the truth is, that the Flonzaley Quartet, the most idealistic and artistic players of chamber music in the world, are known and loved all over this country. Season after season they have toured far and wide, returning each year to towns of no more than a few thousand inhabitants, who feel that unless they hear these players each year a big gap remains in their music season. Nor are they satisfied with anything but the best programs the Flonzaleys have to give. Said one of the members of the quartet to the present writer not so very long ago:

"We look forward to our engagements in these smaller towns as among the keenest pleasures of a season. The people are delightful and charming to meet and they possess unusually good musical taste."

It took a good many years for the Flonzaleys to build up a clientele all over the country because they never make a single concession to popular demands. Now they are booked solid from fall to spring every year. Not a member of the quartet ever accepts any engagement for an appearance as soloist or in any other capacity. They play only as an ensemble. This is that they may retain the perfect unity in their playing that would be impossible if they indulged in individual work.

Having appeared in more than four hundred American cities and towns, the Flonzaleys on that evening of their first broadcasting experience were heard by tens upon tens of thousands far distant from New York, not as strangers, but as friends.

Did Ethel Leginska Seek Publicity?

WHEN Ethel Leginska's concert with the New York Symphony orchestra was broadcast from WEAF it aroused special interest because it was the first time a woman had conducted an entire orchestral concert in this country. Miss Leginska is known both as pianist and composer, with a *flair* for the extremely modern in the latter medium. Then she displayed this ambition to prove that she could also be a conductor, a perfectly legitimate ambition indulged in by various famous men pianists.

Her disappearance, recently, while the audience waited for her to give a piano recital at Carnegie Hall failed of the dramatic effect which we assume was intended. Genuine artists are not temperamental. They are about the sanest people in the world. Were it otherwise they would not have the poise to appear before the public repeatedly and give masterly interpretations of the musical masterpieces.

ETHEL LEGINSKA

Who recently mysteriously disappeared and was later found. She is the only woman ever to conduct a Symphony Concert. It was heard through WEAF

Novaes an Excellent Feature of One Brunswick Program

THAT was a happy thought on the part of the Brunswick Phonograph Company to have Mme. Guiomar Novaes play a Brazilian program for her initial radio appearance made through WJZ and WGY and other stations. Novaes is not only the greatest woman pianist, next to Carreno, who has come to us from South America, but she is one of the foremost women pianists from any country now before the public. Radio assuredly has its moments of uplift when such an artist can be heard by a vast audience. Novaes has toured this country many times since she first came here as a shy young girl still in her 'teens.

BROADCASTING STUDIO OF THE "BROOKLYN DAILY EAGLE"

Which is operated in connection with station WAHG, at Richmond Hill, New York City. H. V. Kaltenborn, associate editor of the *Eagle*, is here seen before the microphone about to broadcast one of his noted "Current Topics Talks," formerly one of the biggest features at WEAF, and now a regular feature of the *Eagle* programs. Also in the picture are George Currie, chief announcer at the studio (at the left), and at the right, Elmer M. Applegit, radio editor of the *Eagle*

Newspaper Radio Programs Are Incomplete

COMPLAINTS are constantly coming to this department regarding the failure of the radio programs published in the newspapers to make clear what kind of performances can be heard from certain stations at certain hours. These complaints are frequently accompanied by outlines of suggestions whereby this condition that so hampers the listener-in may be remedied. But

none of them has been especially practical. It will take a long time to solve this difficulty.

At present, the newspapers in printing these programs are throwing away space that, in its prodigality, astonishes one. What does an entire page in the Sunday New York *Times* cost if bought for advertising purposes? Something prodigious, you may rest assured. Yet, there you see it, each week, filled up with radio programs most of which, so far as giving the reader any real enlightenment of what he may hear during the week, might just as well never have been printed.

We will lift two of these programs bodily, and let you see for yourself. Here is one headed WCAE, Pittsburgh. The questions in parentheses are, of course, our own.

6.30 P. M. William Penn Orchestra
7.30 P. M. Bedtime Story
7.45 P. M. Address (What about? Turnip growing or tax regulation? Or art?
8.30 P. M. Concert (What kind?)
9.00 P. M. Gypsy String Ensemble (That explains itself.)
10.00 P. M. Concert (What kind?)
11.00 P. M. Orchestra: songs. (Is this a jazz concert or a concert of legitimate music?)

Follows a WGY program; we refrain from comment:

2.00 P. M. Music; talk, Mrs. E. P. Pressy
6.00 P. M. News. Market reports
6.30 P. M. Dinner music
7.45 P. M. "Income Tax," J. F. Zoller; A. O. Coggesshall, tenor.
8.00 P. M. John Leather, baritone; talk.
10.00 P. M. Same as WJZ.

MME. GUIOMAR NOVAES
Brazilian pianist, recently heard from WJZ, WGY, WRC, and KDKA

Do not let it be understood that we are laying the blame for this weekly printing of useless bunk on the heads of the radio editors. That is, not wholly. With the full advance programs they receive they could do much better with the leading stations than is now the case. The larger stations send out full programs, giving every number in detail, weeks in advance. But with the majority of the stations the situation is, we grant, almost hopeless.

This is a big subject. One of these days we are going to have a good deal to say about it. But the time is not yet ripe.

FROM station KSD, St. Louis, comes the good news that the recitals recently given from that station by Francis Macmillen, concert violinist, brought in more mail and from a more discriminating and interested group of listeners, than any one event in the history of the station. Mr. Macmillen presented the same kind of programs he gives at his regular recitals on tour, with no concession whatever to "popular" taste. Yet there are hundreds of program directors who are still unconvinced that the radio public cares for anything but rattle-clap music.

Are All Telegrams to Radio Stations Laudatory?

BROADCASTING directors are not prone to read to their listeners-in during a program the derogatory comments that come to them by wire or telephone. Here is such a comment that a man writes us

he sent to a well-known station that was tearing the air to tatters with jazz.

"Discharge your orchestra and install a small air compressor attached to several tin fish horns. It would be more economical, louder, and the musical effect would be the same."

Cross Word Puzzles vs. "Music Memory" Contests

IT HAS been said that the cross word puzzle has drawn thousands of owners of radio sets from the loud speaker to the dictionary. But we would put up quite a good-sized bet that, during the evenings of the "Brunswick Music Memory Contests" the cross word puzzle gave way in interest to the musical puzzle involved in this contest. Artists that the listeners were assured were well known, and many of world fame, sang or played with no introductory remarks to give any indication who they were or what compositions were being performed. But the names of some of the artists to be heard were published in advance, but no indication given as to when they would appear. The Brunswick company arranged a schedule of awards totalling five thousand dollars for those guessing correctly the largest number of names both of artists and compositions. That would mean some guessing, and done without a dictionary, too! At this writing the winners had not been announced.

Where Announcers Are Perfect

STATION WCCO vouches for the absolute truth of this story. Their chief announcer, wishing to improve the carrying power and quality of his voice, went to a voice specialist in Minneapolis. He already knew something of the subject, but wanted to become as proficient in his announcing as possible.

The voice specialist dealt with him with weary patience for some lessons, and then, one day, exclaimed:

"See here! The best way for you to learn voice control is to hear perfect tone production every day. I advise you to listen to that new announcer at WCCO. I don't know his name. But he has all the qualities it seems impossible for you to learn."

Unpardonable Conflict in Good Programs

THE excellent Brunswick broadcasting program featuring their "Music Memory" contest, and the "Eveready Hour," both of which have come to be ac-

MISS MIRIAM STEEP
Star of the Washington Square College Players, is being heard in a series of radio dramas through station WJZ

MISS MARY HOWARD

Soprano, of San Antonio, Texas, who is in New York studying singing, is here seen broadcasting the song, "Texas" through station WEAF in honor of "Ma" Ferguson's inauguration that was then taking place. Special amplifiers made it possible for the audience at Austin to hear the song clearly

cepted and eagerly awaited features of Eastern radio programs, were scheduled for the identical time on Tuesday night, February 10. Assuming that the radio audience is kindly disposed toward both programs, it is obvious that they cannot listen to both at the same time.

Good showmanship is more and more coming to play in the arrangement of radio programs and there is no doubt that in particular, the programs of these two organizations are as near the ultimately desirable radio entertainment as anything we now have in this country. It is hard to understand just how those responsible for the radio programs of these two companies failed to discover that there was a conflict in time. One assumes that the conflict is unintentional. If it is by direct design, there is absolutely no excuse for it.

Europe for Good Programs, America for Good Performances

A STUDY of the programs put on at the station of the *Compagnie Française de Radiophonie* as they are received week by week, shows that these programs are much superior in quality to those given in this country. And they are much better compiled. Classical music is not mixed with popular music, any more than it is in any regular concert programs. But regarding the quality of the performances, witness an enlightening communication of Eleanor McLellan, New York voice teacher who has recently returned from a number of months in Europe. She says, in part:

> I made something of a study of radio programs while in Europe, and listened-in twice in Paris and once in Switzerland. The programs, so far as quality of selections is concerned, are far superior to ours, which seem to be growing worse every day. But in the quality of the performances, the programs are decidedly inferior to ours, especially the singing. Our cheapest vaudeville houses demand better voices and singing than I heard when I listened-in over there, and yet they were supposed to be artists who were broadcasting. They were simply terrible. For that matter, the singing was equally bad in the public performances I heard. This degeneration of the singing art seems to have come to Europe since the war, at any rate since I was last there. Our supposed second-class artists are so much better than the best they have over there now that they simply cannot be compared. Of course, these defects show up with merciless truth over the radio. In a nutshell, I would put it, Europe for good radio programs, America for good radio performances.

DR. W. M. CLARK, of Indio, California, writing regarding the stupidity of reading telegrams during a radio program asks: "What would the audience at a theatre think to have the hero of the play make the announcement between the acts: 'Mr. Blank, who is sitting in the gallery, has just sent down word that he can hear every word of the play distinctly.'"

JOSIAH ZURO

Conductor of the Sunday Symphony Society, whose concerts have been broadcast every alternate Sunday from WJZ. Mr. Zuro is also an operatic conductor of far more than average ability

The Physics of Sound

The Nature of Sound—How It Is Produced, How It Travels and Its Importance to Radio

BY B. F. MIESSNER

COMMUNICATION, since the first days of man and beast, has been the one great instinctive force responsible for the increasing pace of progress through the ages. From the grunts of our primeval ancestors to the radio of to-day, the progress of mankind has followed the progress of communication.

There seems to be some definite relation between the facilities for disseminating ideas and the development of civilization. Certainly, the spreading of news is vital to the progress of humanity.

The South Sea Islander, with only smoke clouds or tom-toms with which to spread his news, is still in the uncivilized barbarous state of our own progenitors thousands of years ago. And why? Principally because the knowledge and ideas of other peoples the world over has not been carried to him. He has stood still because he has been isolated.

© Merl LaVoy

FIG. 1
South Sea broadcasting is simple and effective but limited in range and restricted to code signals

The highest type of communication yet developed is radio. Everywhere, instantly, it spreads its mystic, sound-bearing force and man progresses faster than ever before.

In radio as in so many other forms of communication, it is sound we broadcast and sound we receive, and so it is toward sound itself that we direct our attention, the better to understand and more highly to develop the usefulness of radio.

SOUND IS BOTH PHYSICAL AND PSYCHOLOGICAL

SOUND is the sensation produced by the action of vibrations of matter upon the hearing organs of living beings, and is therefore a physico-psychological phenomenon. The old catch question of the physics teacher:

"Does a falling tree in a forest make a noise if no one is present to hear it," can be answered "No", because sound is only the auditory effect of the forces we call sound waves. Generally, however, the word "sound" refers to the sound waves or vibrations themselves rather than to the sensations they produce, and because this usage is so general it will be adhered to in these discussions on sound and radio.

SOUND PRODUCED BY VIBRATION

THAT sound is produced by rapid movement of matter can easily be demonstrated. A piano string when struck appears blurred and wider than before, and the vibration can be felt with the finger; the vibrations of a phonograph or loud speaker diaphragm can also be felt; a vibrating tuning fork provided with a sharp point and drawn over a smoked or waxed surface will trace its vibrations visibly. We need only clap our hands, force air through our vocal cords, or tap our pencil upon the table to show that the rapid movement of matter generates sounds. If we view a phonograph record through a magnifying glass and see for ourselves how the needle is vibrated by the wavy-lined groove in which it rests, we can understand that vibrating bodies set up vibrations of the air surrounding them which we hear as sound. When it is desired to produce sound of considerable magnitude and the vibrating body itself has only a relatively small area of contact with the air, an auxiliary body of large area and responsive to the vibrations of the smaller body is connected to it. By this expedient a small

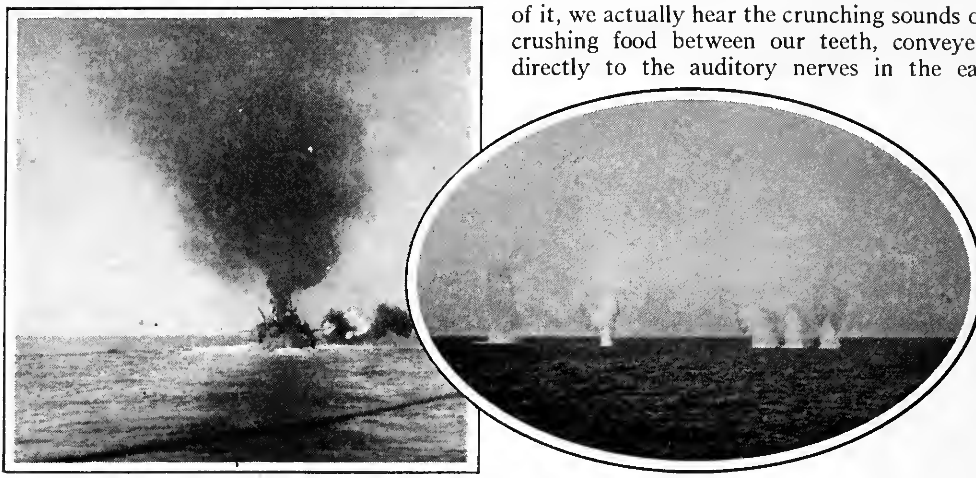


FIG. 2

Naval target practise demonstrates very well the varying velocities of light and sound. The light, smoke, etc., from the gun muzzle is seen long before the sound of the detonation is heard

body vibrating with great force but unable to get a grip on the air, is able to transfer a large part of the energy of its vibration to the air, which appears as sound energy. The sound board of the piano, the belly and back of the violin, the drum heads in percussion instruments, the diaphragms of phonographs and telephones, the air columns of amplifying horns and wind instruments, are concrete examples of this principle common in everyday life.

THE NATURE OF SOUND

THE vibrations or movements of bodies in contact with the air thus impart some of their energy to it which appears in a form which we hear as sound, and which we call sound waves. Like light and heat and radio, sound is a form of energy capable of acting through space. While the former are vibrations of an omnipresent substance called the ether, and travel with least resistance through empty space, sound waves require some actual physical substance, such as solid, liquid, or gas, for their generation and propagation. This can easily be demonstrated by suspending a vibrating electric bell in a bell jar and pumping out the air.

While sound is ordinarily thought of as existing only in the air, most of us are familiar with sounds in other substances to some extent. All of us who swim have surely heard the sounds of clapping stones made by a comrade under water as we submerge our head. Many of us, too, have listened to the approach of a train miles away with ear to the steel rail of its track. While most of us are unconscious of it, we actually hear the crunching sounds of crushing food between our teeth, conveyed directly to the auditory nerves in the ear through the bones of the head from the teeth.

THE VELOCITY OF SOUND

UNLIKE the waves of light or radio in the ether, which travel at the amazing speed of 186,000 miles per second, sound is a relatively slow moving force. Who has not seen the flash of a distant gun, of a stroke of lightning, or the rush of steam from a whistle and heard its sound come pealing in some seconds later? The light and sound are produced at the same instant, but the light travels so fast that its visual effect is practically instantaneous; the sound is relatively very slow, taking roughly five seconds to the mile for it to reach the listener.

The distance of any object which produces sound and some visible effect simultaneously, such as those above mentioned, may easily be determined by counting the seconds elapsing between the sight and the sound and allowing eleven hundred feet of distance for each second so counted. Three different degrees of velocity are most wonderfully illustrated in naval target practice to those aboard the target towing ship. The demonstration is particularly beautiful at night. As the battleship six miles away lets go a salvo, we see first the bright yellow flash of the powder explosion as the projectile rushes out of the gun muzzle on its journey to the search-lighted target a few hundred feet behind our ship. If the shells are provided with luminous tracers, we see the comet-like shell coming on at a tremendous pace, for about ten seconds. Then almost

simultaneously we see the huge geyser-like splash of the shell impact with the water near the target, and hear the roar of the splash and the crack of the atmospheric bowwave of the shell. Then, last of all, twenty seconds or so later, comes the deep booming roar of the sound.

THE SPEED OF SOUND VARIES WITH SUBSTANCE CONDUCTING IT

THE speed of sound depends chiefly on the nature and condition of the substance in which it occurs. In air it changes slightly with the temperature, and also somewhat with the intensity of the sound itself. It increases slightly with both temperature and intensity. In air at thirty-two degrees Fahrenheit, its speed is 1090 feet per second. In salt water at the same temperature it is about 4770 feet per second, and in steel it increases to the relatively rapid rate of 16,400 feet per second.

An extremely effective method of measuring ocean depths is now used in oceanography. A powerful sound is generated in the water by a vibrating diaphragm several feet in diameter energized by several kilowatts of electromagnetic energy. This sound travels to the bottom of the ocean and is there reflected or "echoed" back to the sending ship, where a submerged microphone receives it. Measuring instruments record the elapsed time between the transmitted toot and its received echo, and the whole distance to the bottom and back is the product of this time in seconds and the velocity of the sound in the water. The actual depth is obviously only half of this distance.

When we speak of waves we think of a disturbance or movement of some kind imparted at one end of a series of particles and transmitted to the other end by a progressive transfer of movement through the series. Thus a row of billiard balls struck sharply at one end will transmit the impact successively through the series without appreciable movement and the last ball will fly away. A very long coiled spring, if pushed or pulled suddenly so as to compress or elongate it, will carry a wave of compression or elongation from one turn of the coil to the next toward the farther end, which gradually becomes weaker and finally dies out. A long rope suspended at one end and suddenly jerked at the other will transmit a distinctly visible wave pulse to the suspended end.

HOW WATER WAVES ARE PRODUCED

PERHAPS the most familiar example of wave motion is that set up in a water surface by a falling stone. Here the stone in entering the water pushes it aside, thus forming a small crater-like rise in water level about it, and as it sinks, a depression in the water above it. The high portion, because of the presence of the stone, can only move outward in its tendency to equalize the water level. The depression left by the stone in sinking also is a center of disturbed equilibrium, and the tendency there is to move upward. As the water there moves upward it acquires momentum which causes the central portion to rise higher than the normal level, so that now a distinct peak forms where the depression was before. Again this peak drops down, forms another smaller depression, rises to form another smaller peak, and so on. Thus the falling stone has created a center of dis-

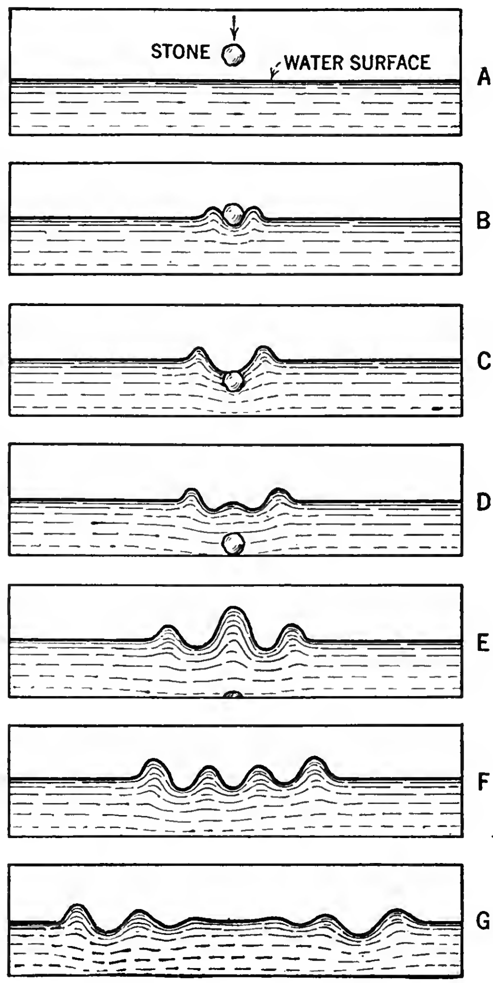


FIG. 3
How waves are produced when a stone is thrown into quiet water

turbance in the water surface which changes from high to low in a regular fashion and sets up a series of several circular waves with gradually diminishing force. While the particles of the water merely move up and down, the wave advances outward in widening circles. Slow motion pictures of divers in aquatic sports show these effects very clearly.

The size of the waves depends largely on the size of the stone, and their force upon the velocity and weight of the stone, If the stone is large, a longer time is required for the raised water at its edge to flow back and fill up the depression than if the stone is small, and so the speed of the up and down vibration of the water particles is slower; that is, the frequency of the up and down vibrations of the water is less. For the same reason the distance between two successive crests, or wavelength, is longer. Incidentally the splash of the stone creates a hemispherical sound wave whose pitch is lower the larger the stone.

WATER WAVE EXPERIMENTS

MANY very interesting experiments with water waves can be made at home in the bath tub. Like the old philosopher, Archimedes, who discovered the laws of buoyancy while in his daily bath, so can we discover for ourselves some of the principal laws of acoustics by experiment with water waves If the rays from the bath room light fall on the bottom of the tub through the water, and if drops of water from a slightly open faucet take the place of falling stones, the waves may be observed as shadows moving over the bottom of the tub. Reflection or echoing from flat surfaces may be visualized very clearly. Likewise the focussing effect of the curves at the corners of the tub may be seen with ease. Further, the bending of the waves around objects of different size, shadows produced by fairly large obstacles. In fact nearly all the laws of acoustics may thus be demonstrated most simply. Numerous photographs of water waves will be included in later installments of this series.

ATMOSPHERIC WAVES LIKE WATER WAVES

WE CAN produce waves in the atmosphere in much the same manner that we produce waves on water. The normal pressure of the atmosphere caused by the gravitational attraction for its gas particles, is 14.7 pounds per square inch at sea level. At higher elevations this pressure decreases, and at lower levels it increases. This normal pressure corresponds to the normal pressure of water at some point in a tank, or to the normal level of its surface. Just as there is a tendency to equalize any change in this normal level produced at any point within it, so there is the same tendency in the atmosphere, or in fact in any gas, to equalize any variations in its pressure however produced. If we suddenly change this pressure at some point, a center of disturbance is created from which sound waves will radiate in all directions. Thus, by suddenly breaking an electric light bulb containing no air, we introduce a center of practically zero pressure. The surrounding air at comparatively high pressure, rushes into this void in its tendency to equalize the pressure. The air particles surrounding these also move

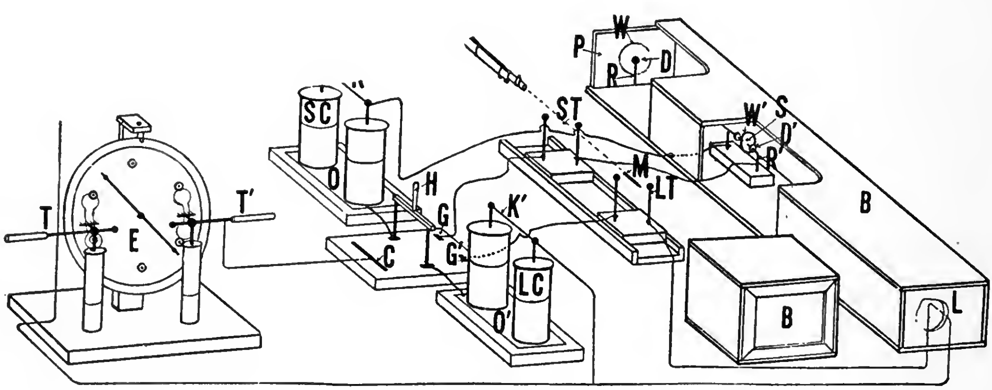
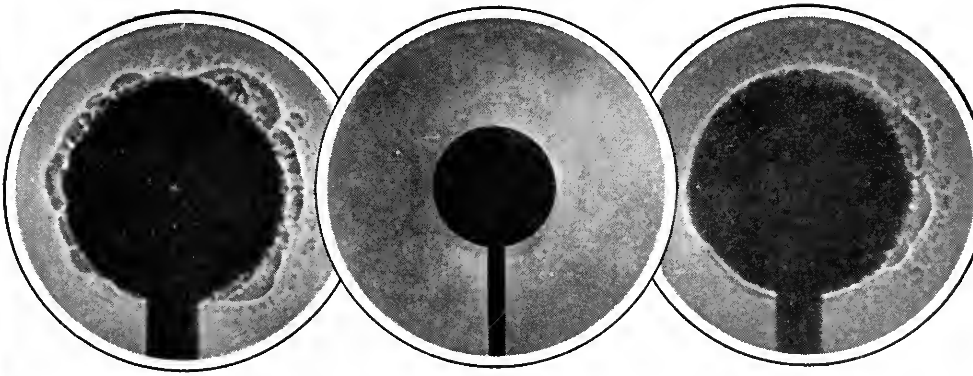


FIG 4.

A diagram of the apparatus used by Professor Foley to visualize sound waves. E, the electric machine, charges a battery of leyden jars for the sound spark S, and another for the illuminating spark L. Trigger gaps ST and LT, connected in series with these two circuits, are shortened when a high velocity bullet is shot through them, whereupon the sound and illuminating sparks are passed in rapid succession. The time interval between the two sparks is determined by varying the distance between the two trigger gaps



Courtesy Riverbank Laboratories, Geneva, Illinois

FIG 5.

The photograph in the center shows the circular shadow of the spherical wave produced by an electric spark behind the central disk. The photograph on the right shows the reflection or "echoing" of a spark sound at the surface of a hard body. In the first photograph, the absorption of a spark sound by a pad of soft felt is very clear. All these photographs were taken by the device diagrammed in Fig. 4

inward to fill the partial void left by them, and so a wave of reduced pressure moves outward in all directions, forming a spherical shell of reduced pressure which expands like a toy balloon as it moves away from its center.

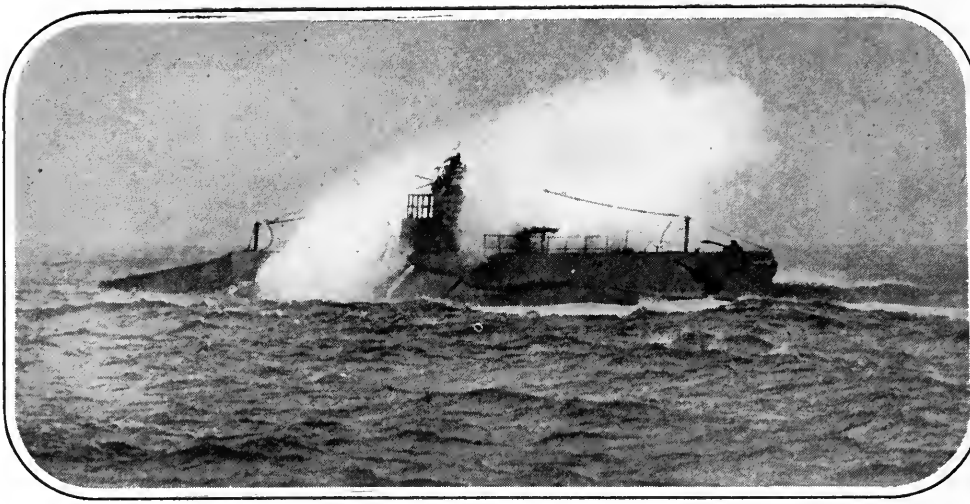
As in the case of the water waves, the air, in rushing into the vacuous space, gathers momentum as it goes, and instead of just filling up the space to normal pressure it goes past the normal and actually increases the pressure. In returning it again passes the mark on the low side, and so on. A short series of waves of alternate low and high pressure are thereby set up, the outermost one of which is a reduced pressure shell or "rarefaction." It will be noted here that while the water particles moved in a direction at right angles to the direction of motion of the wave, the air particles in sound waves move back and forth along the lines of motion of the wave itself. The particles in the rarefaction are moving opposite to the direction of wave advancement, those in the compression in the same direction.

The process above described may be reversed by the sudden introduction of a high pressure center instead of the low one just described. The firing of a gun introduces such a center. In this case the high temperature gases rush out of the gun muzzle behind the projectile, forming a wave of compression, following by one of rarefaction, etc. In this case, because of the great length of the gun barrel, considerable time is consumed in emptying and filling the gun barrel in the pressure equalizing process and the pitch character of the sound is lowered accordingly. As a matter of fact the nature of the sound changes with the size and length of the gun barrel because of this fact. Short barrels produce sharp, piercing sounds having high pitched characteristics; long, large bore barrels produce low, booming sounds of low pitched character.

SOUND WAVE PHOTOGRAPHY

A VERY beautiful method of visualizing certain kinds of sound waves has been perfected by Professor Arthur L. Foley, of Indiana University. He generates a sound pulse of very short duration and of high intensity by a powerful, instantaneous, electric spark. The wave so produced is allowed to spread outward to the desired point, when a second spark is produced whose light, in its path to a photographic plate, passes through the sound wave of the first. The variations in density of the air in the sound wave cause a refraction of the light from the illuminating spark, that produces a shadow of the wave on the plate, and therefore a picture of the wave itself. The beauty of this method may be appreciated when one considers that the interval between the first and second sparks, and therefore the point at which it is desired to picture the wave, may be controlled to within one hundred thousandth of a second.

Many obscure phenomena of sound have been investigated in this manner and much has been learned. The accompanying figures show the arrangement of his apparatus and several photographs of sound waves made with it.



WHEN RADIO AIDED

The S-19 recently grounded on a reef, near Cape Cod. The sos from the ship brought them help during one of the worst storms of the winter. It was snowing, and the wind was high but the radio warning brought the Coast Guard from near Nauset Beach, Massachusetts.

THE MARCH OF RADIO

By J. H. Morecroft

Past President, Institute of Radio Engineers

Fearless Statement of Fact Is Not Illegal

AN EXTREMELY important decision was reached on January, 30, 1925, by a jury sitting in the Federal Court of Judge Garvin in Brooklyn. The case involved the publishers of RADIO BROADCAST, who were sued for libel by the originator of the "Kaufman Circuit," a peculiar type of regenerative circuit which was generally brought to the broadcast listeners' attention during the last two years. The circuit was, in our opinion, a hodge-podge arrangement of various coils and condensers and it was characterized as in no real sense "new" in an excellent article by Mr. Zeh Bouck appearing in RADIO BROADCAST for March, 1924, entitled, "The Truth About Trick Circuits." Naturally after the appearance of unfavorable criticism in such an unbiased medium as RADIO BROADCAST always endeavors to be, sales of parts for the so-called Kaufman Circuit fell off, whereupon Mr. Kaufman claimed that his personal character had been harmed to such an extent that he was legally entitled to damages.

The jury, after a very brief review of the evidence, decided that no libel had been shown, thus vindicating once more the cause of truth-telling. Had the case been decided differently, a great harm would have been done to the average broadcast listener. There are always people who are continually getting up new circuit arrangements and marketing them at a profit to any who have heeded the extravagant and unwarranted claims made for them. Many times the average radio enthusiast is not able to judge of the accuracy of the claims put

forth and finds that he has been deceived only after investigation of the worthless material.

It has been and will be the aim of RADIO BROADCAST fearlessly to criticize and expose all such impositions upon the radio public. If, after our careful analysis and truthful exposure of a circuit or device the "Inventor" suffers loss of caste (as Mr. Kaufman claimed was his plight), he can then blame only his own unfortunate ignorance.

Telling the unpleasant truth about a radio set certainly is not libel, and it is a sound rule, not necessarily confined to the radio field that one should not permit one's name to be too intimately connected with a development or event which won't stand up under honest criticism.

This Radio and the Stage Nonsense

STAGE-FRIGHT is an ailment which is likely to attack nervous performers, the performer being supposedly on a stage of some kind. Managers are, of course, worried about their *protégés* suffering from such attacks, as their earnings generally suffer. But now we have the interesting spectacle of stage-fright among the managers themselves. They seem to be on the point of nervous breakdown because of the relentless attacks they think that radio is making upon box-office receipts. Receipts are falling off at a tremendous rate, they say, because people prefer to sit at home and get their enjoyment by radio at no cost and no inconvenience. Rainy nights and dirty taxis cannot bother the radio listener.

It is extremely questionable that radio has had any such effect on the public's patronage of the stage. To offset the panicky statements from some of the stricken managers, we quote from a recent letter of Mr. William H. Priess, a well-known radio engineer and executive:

> Broadcast entertainers are in two principal classes: those whose main income is derived from the sale of seats in theaters and concert halls and those whose main income is derived from the sale of talking-machine records.
>
> Both classes benefit directly when their members broadcast. The sale of seats for their entertainments and the sale of their records is enormously stimulated. Their income increases greatly. Their managers and employers will realize this in a very short time and will make them see it too.

It would seem that those theatrical folk of reasonably broad vision have already seen the truth of this assertion. The broadcasting

REPAIRING A BROADCAST STATION ANTENNA

New lead-in wires are being put in place at WJZ-WJY, New York. The rigger is suspended by a cable midway between the two masts which rise 100 feet above the 20-story building on which they are installed. The square house between the towers is the apparatus room for the twin stations, the control room and studio being on the sixth floor

by Brunswick and Victor artists is being done in no eleemosynary vein. The managers of the artists concerned and the talking-machine manufacturers have determined that it is good business. But many of the managers (the less important generally) hold that radio is making real inroads on their fields. In the words of one of them—"The theater, the radio, and the disc are engaged in a battle from which one may not survive. Let Equity (the actors' guild) provide in its contract that an actor may not take part in a process which may prove his own destruction."

Some of the managers rather disparage radio as a competitor of the stage. Lee Shubert, for example, says: "Just at present radio is new and the public may stay at home for a while listening-in, but the novelty will wear off and they'll return to the theater. Radio cannot keep people from the theater because it cannot broadcast personalities and situations."

It may well be that the stage has recently fallen into disrepute with many of the theatergoers, as some of the managers seem to think the box-office receipts indicate, but if so it is more likely that the pernicious practices in which the managers themselves indulge may have something to do with the public's contempt. A short time ago we tried to get some front seats for one of the revues. The box office sold no seats farther front than the twelfth row, we were informed,. They sold all the best seats through the agencies according to the dictum of the presiding genius at the theatre's box office. Inquiry at the agencies disclosed that not only did they not have third row seats but they would not take an order for such as the best they could engage to deliver were sixth row seats. Where the best seats were disposed of they pretended not to know. In fact, at two of the agencies they showed considerable rancor that such an exorbitant request should be made! One can only conclude that the best seats are disposed of at a considerable advance over the advertised price to scalpers and curb speculators, and it is only by dealing with this undesirable class of vendors that one can buy the best theater tickets. It seems very likely that if the theater is gaining disrepute, it is pernicious practice of this sort rather than radio competition that is bringing it about.

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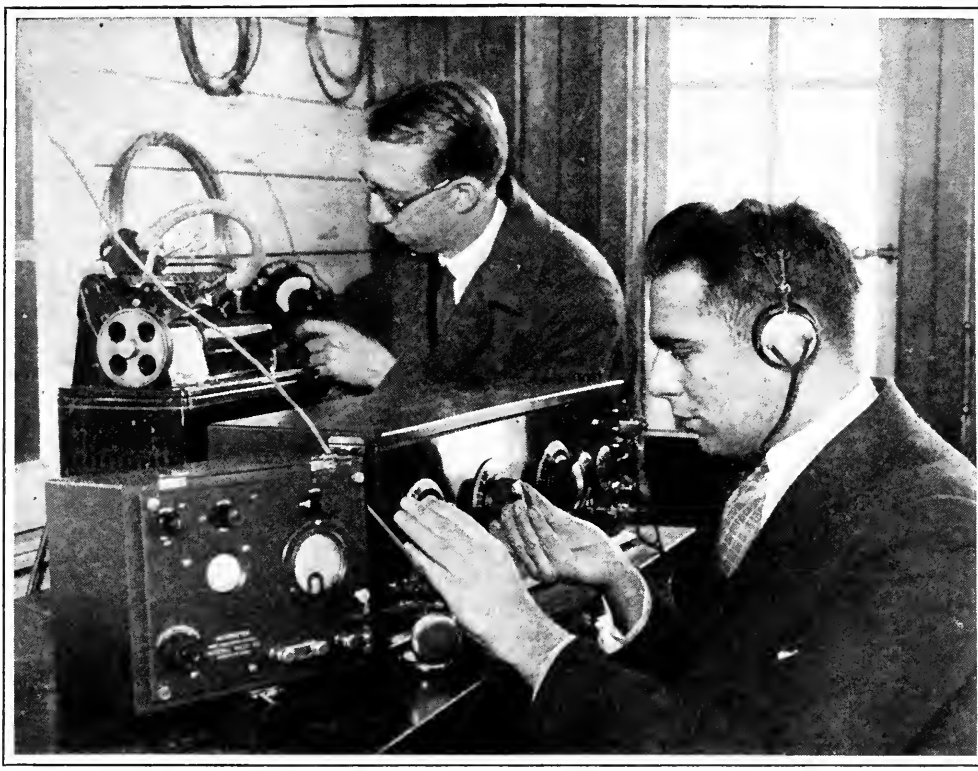
THE RADIO ROOM OF MARCONI'S YACHT

The *Elettra*. Equipment of almost every sort is here, including receiving apparatus for very long and very short waves. Signor Marconi has lately been conducting experiments with short waves and found that on those from 100 to 32 meters, the daylight absorption decreased rapidly with the shorter waves. It was also found that reflectors at the transmitting station, using very short waves, increased the strength of the received signal and diminished fading



RECORDING RADIO SIGNALS

During the total eclipse of the sun in the RADIO BROADCAST laboratory at Garden City. Signals were received from WGY, WBZ, and other stations. The photograph shows John B. Brennan (right) and Keith Henney (left), both of the laboratory staff with one of the receivers used in the measurements. The dictaphone at Mr. Henney's left was connected to a loud speaker unit attached to the receiver and continuous records made of the signals of various broadcasters before, after, and during the eclipse. Effects noted in the accompanying editorial were observed

What the Sun's Eclipse Proved About Radio

IF ANYONE had expected to find great and sudden changes in radio transmission during the recent total eclipse of the sun, he was doomed to disappointment. It had been confidently predicted, and not without some foundation, that, in the path of total eclipse, radio transmission would greatly improve during the time the moon intercepted the sun's rays. We do know that night transmission is better than that during daytime, and as it might well be expected that the moon would act as a complete shield against the sun's active rays, improved transmission during the eclipse seemed sure.

As a matter of fact no such thing was observed at all. Many skilled observers, having carefully planned their work and apparatus days in advance, submitted reports which in several cases are almost unbelievably opposite to each other. From Schenectady to New York the radio waves had to pass completely through the hundred or so miles of shadow. One observer in New York noticed that WGY became very steady, with no fading at all during the eclipse, and two others report that WGY disappeared completely during the eclipse!

Further to upset our ideas, the short wave station at Schenectady was well received in New York both before and after the eclipse, but during the period of totality disappeared altogether. And while this was happening in New York the short wave from Schenectady was not received at all during the observations in Ithaca, only 150 miles away by G. W. Pickard, one of the ablest experimenters in radio to-day. He reported that the short wave station of Schenectady could not even be heard in Ithaca, much more measured.

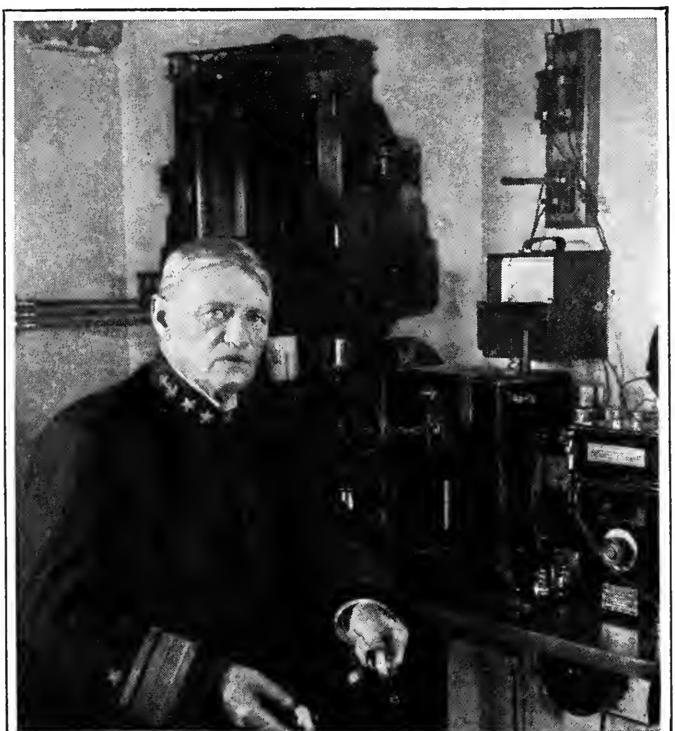
So we have at our disposal these facts. Radio transmission at night is much better than during the day. Short wave stations in Schenectady and Pittsburgh have been heard halfway round the world. During the eclipse, which we have assumed was night time for radio, the short waves traveled in the direction of movement of the moon's shadow less than 150 miles. In a direction across the shadow's path, they traveled reasonably well both before and after the eclipse, but during the eclipse they completely disappeared. And while these contradictory effects are being noted directly in and around the moon's shadow, listeners hundreds and thousands of miles away from the path of total eclipse reported a wonderful gain in signal strength!

And not to have any one spot of the entire field of possible happenings uncovered, engineers at Riverhead, Long Island, listening to Schenectady's short wave, reported no change whatever in the signal strength, although the sending and receiving stations were on opposite sides of the shadow band!

The vagaries of radio transmission are apparently more inexplicable than before the moon cut off the sun's light. This is much more satisfactory than might be supposed, however, because when we know all the secrets of radio, its fascination for thousands of devotees will have disappeared. We knew that there was still much to be learned about radio and the eclipse showed us that there was even more than we had supposed.

Too Many Bootleg Radio Tubes Are Being Sold

AS A result of the investigation of poor tubes being marketed in New York City, Joseph Haberman was found to have been guilty of fraud and misrepresentation and was recently sentenced to three months in the workhouse. He had been buying tubes from a New Jersey manufacturer and putting them up in cartons marked "Radio Corporation of America." The District Attorney who represented the state in the prosecution vouched for the statement that 10,000 spurious tubes were being sold each day in America.



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RADIO TELEPHONY IN THE NAVY—1907

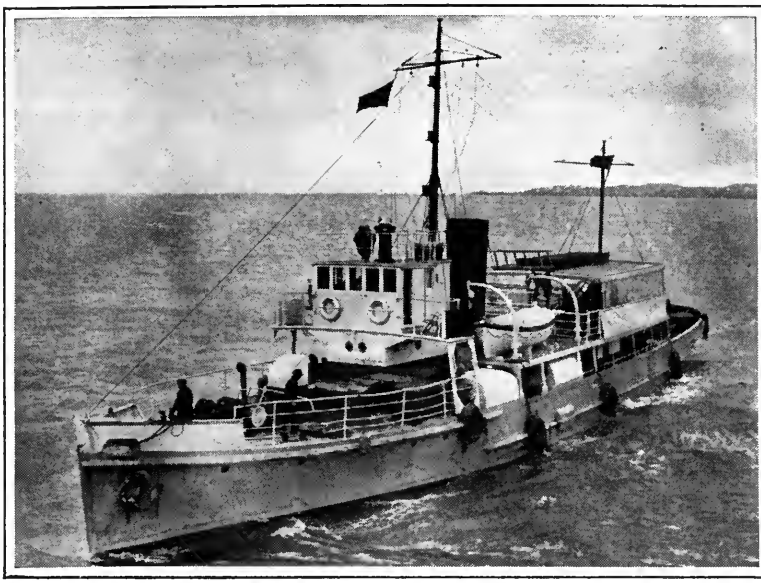
This photograph was taken aboard the flagship *Connecticut* with the late Rear Admiral Robley D. Evans seated in the wireless room in front of the De Forest wireless telephone which was the latest achievement at that time. The transmitting range was quite limited since the power was only fifty watts. The radio telephone was then used merely for inter-fleet communication

New Amateur Regulations

THE Department of Commerce has just issued new regulations for amateur transmitting stations. Every amateur operator should secure a copy of these new rules and adjust his transmitter accordingly. Amateurs are given plenty of wave bands to work in, but these bands are so well defined that the average amateur will have to measure his emitted wave much better than he has in the past. From 4.69 meters to 5.35, from 18.7 to 21.4, from 37.5 to 42.8, from 75 to 85.7, and from 150 to 200 meters are assigned to his use. There will have to

be quite a bit of wavemeter calibration carried out before the average amateur can avail himself of the privileges allowed in these new regulations.

There are two sections in the regulation which will interest the broadcast listener. On spark transmitters, we learn that:



THE TENDER "HAMILTON"

Which ferries passengers from the port of St. George, Bermuda, to liners making it as a port of call. The seaworthy little ship has its radio equipment which is of considerable value in maintaining communication between ship and ship, and ship and shore

> Amateur spark transmitters produce considerable interference and consequently are responsible for many complaints. Amateur owners of such transmitters should abandon their use as early as possible and adopt a system producing less interference. Until such change is made they will be permitted in the wave band between 170 and 180 meters and should have a decrement not exceeding .1.

There are two "shoulds" in this regulation that would serve much better if interpreted as "musts." Under the heading "Quiet Hours" we read "amateur stations when using wavelengths between 150 and 200 meters are required to observe a silent period from 8 to 10.30 P. M. daily.

Stations which have been using between 105 and 110 meters under temporary permit must now move into one of the above specified bands because the 105–110 meter band is now given over to other uses.

What Radio Power Supply Apparatus Should Be

AS LONG as the alternating current filament tube is withheld from the market, the one great improvement in radio which we warmly endorse and encourage, is apparatus which will take power from a lighting socket and run the ordinary vacuum tube set. The idea of using dry cells for all modern radio receivers is somewhat absurd in some respects when viewed from the engineer's standpoint. Dry cells certainly have a special radio application which they should meet, and so has the power apparatus.

The power supply apparatus at present available employs some kind of rectifying cells or tubes, combined with electrical filters to eliminate hum from the receiving set. This type of power supply apparatus is connected to the house lighting circuit. Enough power can be drawn from the house mains so that a fire could be caused by improperly designed equipment. It is most necessary that the radio outfits be made satisfactory from the fire risk standpoint. The flimsy construction of many radio receivers now being sold will not suffice if the set is connected to a power supply device, and the sooner the manufacturers of these devices gets this firmly into his designer's head the better it will be for the art. If these rectifying outfits are designed so that they will pass the fire underwriters' inspection, they will meet great favor.

Receiving Short Broadcast Waves

PERHAPS some of our readers are trying to pick up broadcast programs sent out over the short wave (less than 100 meters) channels. If so, they are probably disappointed by the quality of the received signal. There is a rapid period of waxing and waning in the short wave channels, as we have men-

tioned before, which has the effect of making the received speech or music of peculiar quality. The companies which are using these short wave channels for rebroadcasting have to use a special method of picking up the signal to eliminate this fading effect. Either two or more antennas, at different points, or a very long antenna are used at the receiving station. Either method is unsuitable for the average broadcast listener.

New Religious Broadcasters

THE Episcopalians and Baptists have been foremost in broadcasting religious services, or so it appears to one who listens-in. In addition in New York we have besides some church services, the services of the Federation of Churches and those of the United Synagogue of America.

The Roman Catholics have now entered the radio fold by having a station installed at the Church of the Paulist Fathers in New York. Instruction in the faith of the Roman Catholic Church will be sent out regularly over the channel of WPL, their call letters.

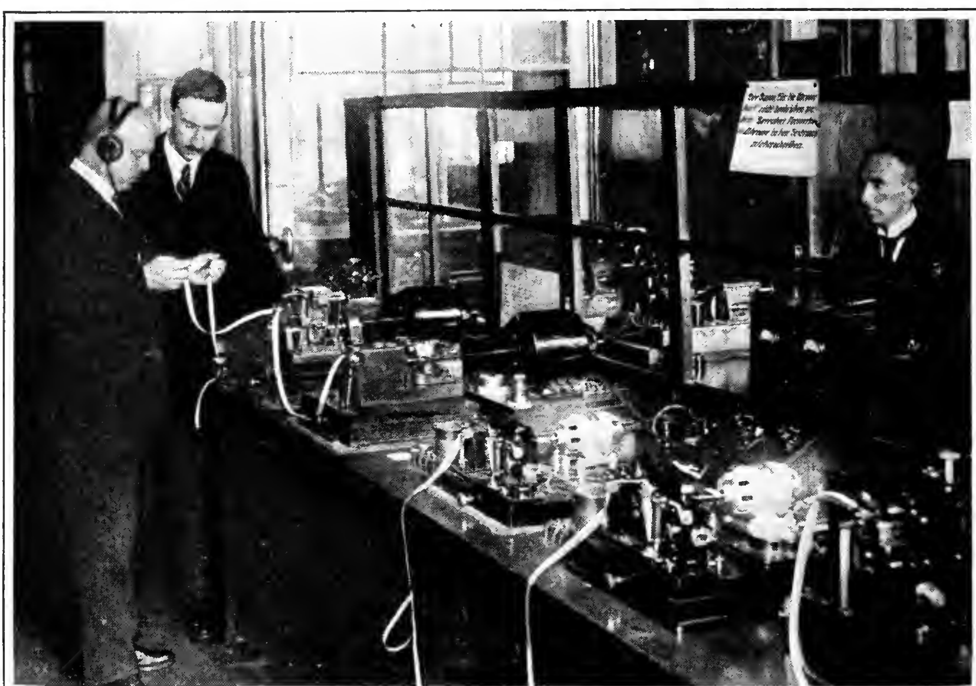
Not to be completely outdone, the Lutherans have installed a station at Concordia Seminary, St. Louis. This station, KFUS, will be used to bring the Lutheran view of Christianity to the attention of those who care to tune-in on its channel.

In addition to these stations, about eight or ten others are regularly operated by religious organizations in various parts of the country.

A Halt to Progress

IF OUR understanding is correct, the newest type of loud speaker introduced in the radio market is to be withdrawn. The paper cone speaker, as it is generally called, designed and produced by the Western Electric Company, was the achievement of skilled engineers combining and improving previously known telephone and loud speaker parts. It accomplished reproduction of music and speech extremely well—in fact, it gave a more natural quality than any other speaker we have heard.

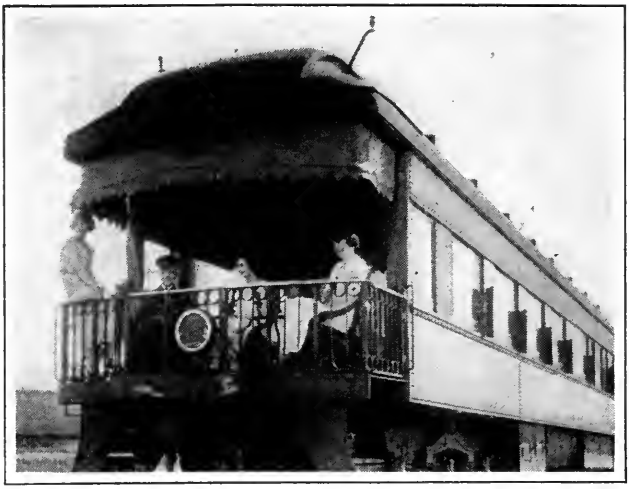
Many people who obtained these 540-AW reproducers were quite evidently disappointed in them, judging from comments made by



RAPID FIRE RADIO

Transatlantic radio messages being received in Germany, direct from Rocky Point, Long Island. The automatic machines in the photograph receive the dots and dashes at high speed and print them on the paper tape from which they are later decoded by operators

dealers and some of the users. Criticism of the quality of these reproducers, however, was not based on real fact. These paper cones give off notes which the other speakers do not reproduce. Well-balanced orchestras produce many low notes which give character and depth to their renditions, but these notes do not appear in the ordinary radio reproduction. Neither the horn type loud speaker nor the audio-frequency amplifier will pass these low-frequency notes along. The paper cone would give them off very well provided the proper current was supplied to it by the audio-frequency amplifier. Practically none of the available amplifiers are designed so that this is done. Because of this defect in the radio circuit, the paper speaker often disappointed its enthusiastic purchasers who had expected much improvement in their radio music.



THE FINAL LUXURY

Passengers on express transcontinental trains can now listen to broadcasting as they while away the hours. The photograph shows passengers on a Canadian National Railways train and the antenna which brings them their broadcast programs. The first transmitting to and from a moving train was done by the Delaware, Lackawanna and Western Railroad about ten years ago, but was largely to determine the advisability of dispatching trains by radio. An entire chain of broadcasting stations has lately been set up in Canada by the Canadian National Railways

We now hear that the paper cone speaker is to be withdrawn from the market because its manufacture and sale violate some kind of an agreement between the American Telephone and Telegraph Company and the Radio Corporation. We sincerely hope that if this proves to be true the Radio Corporation will busy itself in putting out loud speakers equal in quality to those now being suppressed. The radio public wants and is entitled to have the best speaker that science affords, irrespective of agreements of any sort.

About a year has passed since our last inquiry received reproof from the Radio Corporation officials. We venture to ask again, where is the alternating current filament tube? The public is still turning in tremendous revenues to the battery manufacturer by using dry cell tubes in five to ten tube receivers. One of our friends tells us, for instance, that his receiver uses up a set of filament batteries each week! When those who have authority in this matter can see their way clear to marketing the lamp socket tube they will receive hearty praise from the radio public. With power from the lighting company, good audio-frequency transformers, best quality loud speakers, and freedom from squealing receivers, radio really becomes a pleasure. Therefore we regret, if it is true, that the backward step has been taken in the suppression of the 540-AW speaker.

The March of Science

RADIO is a part, even if a comparatively small one, of the vast field of general science, so that we must be interested in the advance of science as a whole if we would appreciate the advancement of our own small portion. The eclipse of the sun brought forth in the New York *Times* an editorial on science exceptional in treatment and language, which we think worth while passing along.

SCIENCE AND LIFE

Perhaps few stop to reflect about the attitude of millions of people toward the eclipse of the sun, and to ask themselves what it is that has made this differ so wonderfully from the mental state of those human beings whom such a natural phenomenon used to fill with superstitious fears. It is one of the beneficent works of science. An attribute of true science is the power of prediction. That has been exemplified in a way which all can understand in the case of the eclipse. Its beginning, duration, and ending have all been minutely forecast. Everybody has implicit confidence in the accuracy of these conclusions of astronomical mathematics. Going behind technicalities, what is it that has been done for the world, in this particular, except to give it the truth, to furnish a complete explanation of a

WILLIAM H. EASTON

New York; Westinghouse Electric & Manufacturing Company

"Short-wave rebroadcasting can provide us with a world-wide system of intercommunication, but the question will immediately arise 'What good will it be if you cannot understand what it says?' The answer is that a universal language will be adopted which all can understand.

There has been a great deal of discussion on this point, especially by those who have gone to infinite labor to invent or learn some artificial speech, such as Volapuk, Esperanto, or Ido. . . . It seems to me that the weight of probability lies with the adoption of some living language, and that, furthermore, the chances are that English will be adopted for this purpose."

natural event? Knowing in advance the thing that will occur, accepting the reasons given for its occurrence, people face with curiosity and keen interest, but without a particle of dread, what in other ages and other climes would have stricken terror to the hearts of great multitudes.

The whole is a good illustration of what science has done, or is endeavoring to do, in a thousand other fields touching upon human life. It is forever in quest of the truth. It seeks to ascertain and to make known to the common intelligence the why and the wherefore of many things that have been regarded as impenetrable mysteries. With every conquest, it not merely enlightens the minds of men, but gives them more confidence, more calmness in the face of the unknown, and banishes haunting fears that have long afflicted mankind. We speak with propriety of the blessings of applied science, but we ought not to forget the great boon which theoretical science has been to the human race. When we note and read to-day of the temporary veiling of the sun in full accord with the scientific prophecy, we should be moved to give a grateful thought to the vast revolution in man's outlook upon the universe which has been wrought by scientific workers in unnumbered laboratories and experiment stations. They had added immensely not only to the safeguards and comforts of life, but to its dignity, its intellectual satisfactions, its assurance that the process of the suns will go on majestically. The endless and sublime search for knowledge which has marked the strivings of star-eyed science has lifted the minds of men to a level where they can feel secure and affirm that it would be a shame to stand in God's creation and doubt truth's sufficiency.

Interesting Things Interestingly Said

HERBERT HOOVER (Washington; Secretary of Commerce). "The greatest development of broadcasting during the past year has not been in the application of new methods of transmission or reception, important as improvements in these lines have been. It is rather in the change of public attitude. Listeners are becoming more and more appreciative of the real service of radio and increasingly critical both as to the character of the matter furnished them and as to the efficiency with which it reaches them. . . . There is a growing realization on the part of the broadcasters of the public responsibilities they assume in conducting an agency so greatly affecting the cultural progress of our people and the innovations of which we hear so much, national programs, short-wave rebroadcasting, increased power, and wired radio . . . —all are based entirely upon the necessity for meeting the growing popular requirement of better service."

FRANKLIN P. ADAMS (New York; in the New York *World*, "The Conning Tower"). "If the theatres are afraid that the average theatrical patron is going to stay at home to hear the radio version of "The Sunshine of Your Smile," or songs to that effect, they are greater cowards than we thought; which is no faint praise. One solution of the Radio Menace problem might be More and Better Plays."

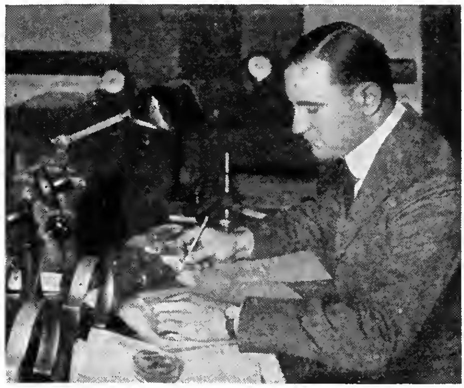
H. I. PHILLIPS (New York; in "The Sun Dial," New York *Sun*). "Now the radio owes its popularity to the fact that no speculator can touch it, and that you can begin listening with $11 in your pocket and still have the $11 when it is all over. Then if you find you are in on a bad entertainment, you can switch yourself right out of it without the assistance of check boys and taxi drivers. It is this take it or leave it principle that is the chief lure of radio, and if the theatre men want to crowd it any they've got to find some way for a man in a theatre to tune himself out of a bum show without any trouble or added expense.

"The show business will never rival the radio for

popularity until it becomes possible for a patron to press a button or twist a knob and immediately turn a very bad actress into eight Hawaiian ukelele players or convert a painful actor into somebody like Lopez or Whiteman."

GUGLIELMO MARCONI (London). "Recent tests from England to the United States, Canada, Brazil, Argentina, Australia, India, and South Africa, using only fifteen kilowatts power indicate the possibility of installing low-power systems capable of day and night commercial radio services to all parts of the globe. For ordinary efficient communication between fixed places or between particular countries, I think the logical thing to do if possible at both points with a view to secrecy and economy is to concentrate all the radiated energy into direct beams. It may be necessary in the near future to regulate by international legislation the use of short waves and to safeguard them from preventable interference."

H. V. KALTENBORN (Brooklyn; Associate Editor, Brooklyn Daily *Eagle*). "Radio co-operates rather than competes with newspapers and magazines. It supplements in a remarkable and delightful way the former means for filling leisure hours. Radio is not a suitable medium for direct advertising. . . . The radio advertiser has no chance to catch the eye. His only appeal is to the ear. . . . Nor can radio, with its limited appeal to a single sense, compete with the many-sided appeal of the speaking stage. . . . The great future of radio broadcasting lies in the field of education. Education comes more easily through the ear than through the eye. There is scarcely a subject taught in a great university which could not be taught over the air but not at the same time that it is taught in a classroom. It is a mistake to suppose that the best results in radio work can be obtained by making it a by-product. Radio requires its own technique."



DR. ALFRED N. GOLDSMITH

New York; Chief Broadcast Engineer, Radio Corporation of America

"High-power (in broadcasting stations) is an experiment, and we must move cautiously. . . I believe that if the higher-powered station is located judiciously, that is, in sparsely settled localities outside the city, it will provide just as good reception for the city folk and at the same time, give the farmers out in Iowa, Indiana, and other agricultural sections a chance to see what radio really can do.

"If the receiving set is really selective, practically no difficulty will be experienced in tuning-out the super-power station, that is, if you are ten or twenty miles away from it. Of course if you are close, a three-circuit set and perhaps a wave-trap may be necessary to tune it out, if it can be accomplished then.

"Super-power is simply a matter of increasing the signal strength over the strength of the static. It stands to reason that if the static and the signal have the same strength, you are going to hear nothing but a lot of weird noises. If the signal strength is increased, you can shorten your antenna, thus reducing the static, while at the same time, the signal will come in with equal or greater force."

EDWARD H. JEWETT (Detroit; President, Jewett Phonograph & Radio Company). "In my opinion, the public should not be made to pay the cost of broadcasting. I doubt very much if it would be desirable to have them pay, any more than they are now called on to pay the entire cost of the newspapers and magazines they read. Advertising carries the load there and it is my belief that advertising should carry the load in making up the expenses of broadcasting. Radio as an advertising medium is a sort of halfway station between the newspaper and the billboard. The message of any advertiser on the air must be limited to a selling message such as a billboard seeks to put across. There will probably develop a school of broadcast advertising which will make advertising messages as attractive as there are to-day in newspapers and magazines."

JOHN GOLDEN (New York; theatrical producer). "If bicycles, automobiles and radio keep people away from the theatre, so does love-making, and where would we all be if we stopped that? It is just as sensible to blame the cross word puzzle as an influence unfavorable to drama. If the theatre cannot withstand the radio, or any other influence, it deserves to die."

I SHOT a joke into the air,
It fell to earth I know not where;
But when I'd sown my meagre chaff,
I listened close, nor heard a laugh,
And felt that pang which all must know
Who've jested through the radio. —*Life.*

The Man Who Knew All About Radio

By WILLIAM H. CARY, Jr.

Drawings by George C. Williamson

THEY sat in the living-room, looking at Brainley Nutmeg's new receiving set —Brainley, his wife, her father and mother, and eleven-year old Junior. It seemed to be all set, but no receiving.

"I do hope it will be going by the time Jack and Jean Mabie arrive," said Mrs. Nutmeg. "They're waiting to see how ours works before they buy a radio of their own."

"So am I," said Mr. Muscadier, with a twinkle in his eye.

"My crystal set upstairs has it all over this one, so far," boasted Junior, tactlessly.

Brainley seemed to sweat under the burden of these last two remarks.

"Well, I'm hanged if *I* know what's wrong," he said. "I've connected up everything just the way it says in the instructions. All the parts seem to be here—I don't know where I'd connect any more if I had them."

He glared at the silent cabinet as if trying to determine what kind of punishment to administer to it. But he realized, on this very first evening of his radio experience, that a receiving set can't be disciplined like a child. It's a lot wiser than you are: you can't bluff it. Punishment only makes it more stubborn and unmanageable. Junk! New, shiny junk, with excelsior-particles still clinging to it. The big receiving set sat on a table in the corner as if it were a god upon a pedestal, with cartons, wrapping paper, and excelsior spread about on the floor, like offerings.

"Well, I'll go over it with the diagram again, and see if I can find the trouble. If not, I guess we're out of luck to-night."

"It will be a disappointment for those friends of yours who are coming," said Grandma Muscadier.

"Who, the Mabies? That's not half of it. I saw James Grunt at lunch to-day and got talking about the new set, and sort of had to ask him to stop in, too."

"Oh Brainley! You didn't!" This from his wife.

"Sorry but I did."

"Oh dear!—he's so—so impatient and sort of superior."

"Well, perhaps he won't know anything about radio."

"I'm sure he won't."

Mrs. Nutmeg said they shouldn't have asked *anyone* to come, the very first evening.

"The very first fifty, you mean," replied Brainley, with his head in the receiving cabinet.

At this point, the doorbell rang, and Junior bounced out into the hall to let in the two Mabies and Mr. Grunt.

"Hello, Nutmegs!" came Jack Mabie's hearty voice. "Well, Brainley, they tell me there's music in the air."

"I guess there is," replied Brainley, with an effort to be cheery. "So far I haven't been able to draw any of it out.

"Jean and I expect to get one like it—if it seems to be a good one."

"I advise you to wait."

"But it's an expensive critter, with those four lights and a big horn and batteries and all that. It *must* be good."

"Good as the day it was born—no more, no less."

With this off his chest, Brainley felt better, and greeted Mr. Grunt with a perverse, almost savage gaiety.

The talk was, of course, on radio. For the first five minutes every one was so busy giving each other their ideas and secondhand experiences that it didn't matter whether the new apparatus was working or not. Mr. Grunt, a slightly bald little bachelor with a cock-sure manner, sat himself down next to Mr. and Mrs. Muscadier.

I THINK it's awfully nice looking," Mrs. Mabie was saying to her husband and the Nutmegs, as they stood gazing at the set. "See how nicely the cabinet is made. Jack, we must have a mahogany one like this. How well it blends with the other furniture in the room."

"Yes, in harmonious silence like the bookcase, apparently," observed Jack. "I wish I could help you out, Brainley, but I don't know the first thing about this radio game."

"As if *I* did."

"Well—you at least have the advantage of having read the directions."

"Call that an advantage, do you? Wait till you've read 'em!"

"Wait'll I take off my coat and roll up my sleeves, too. We might as well both look like electricians, anyway."

Then Brainley handed him the little sheet labeled: "Instructions: Assembly and Operation."

"What'll we do first—blow 'Assembly'?" said Jack, briskly.

"Yes. You begin at the top and read out loud what it says; I'll accompany you on this double-barreled steam-calliope."

Brainley picked up his screw-driver and pliers, and the two men bent over the set like surgeons over an appendicitis case.

It was Mr. Grunt who made things uncomfortable, a few minutes later, by remarking:

"Well, Brainley, how about a little concert?"

And to make things worse, Junior called downstairs from his room that he was getting the local station "swell" on his crystal set.

"It's easy to see where the electrical genius lies in this family," observed Mr. Grunt. "I'm going up to see Junior's machine."

He went; and although it relieved Brainley considerably, it didn't put voice into his newly acquired receiver.

"I give it up," he said finally. "We'll have to get somebody from the radio store to come round to-morrow."

WE MIGHT call up the Flashes next door, "suggested Mrs. Nutmeg. "Mrs. Flash told me yesterday that they've had a radio for three months and it works like a charm. Perhaps her husband could tell us what is the matter. She said he knows all about radio."

"All about it like Mr. Grunt?" murmured Brainley. "I think one expert like that is enough in the house at one time."

"Still," said Jack Mabie, "if this Flash fellow has had a set working like a charm for three months, he might be able to make this one work like *something*, for three minutes."

Mrs. Muscadier called to Mrs. Nutmeg: "I'm afraid your father and I shall have to go, my dear. Perhaps we shall be able to hear it another night."

Brainley was filled with chagrin. Poor parents-in-law! They had sat there listening to James Grunt's half-baked opinions, waiting for the new apparatus to speak, all without complaint or meddlesome suggestion. He hastened to apologize. If they could wait just a few minutes longer, he'd get Mr. Flash right over, and maybe he'd find some simple thing wrong which could be remedied in a minute. He'd call him right up.

The Muscadiers decided that they'd wait a bit, then, and see.

Over the telephone, Brainley described to Mr. Flash the symptoms of the sick receiver. They knew each other only by sight, but Brainley's flattering request for aid, and Mr. Flash's obliging response that he'd be right over, seemed to unite them immediately by the bonds of friendship. When the doorbell rang a minute later, Brainley and his wife both went out into the hall to greet their neighbor, with a welcome that was almost shouted.

"Come *right* in!" said Mrs. Nutmeg, heartily. She introduced him as "Mr. Flash—a real radio expert."

That was an unfortunate introduction to live up to, and it rather knocked the pins from under Mr. Flash—they would expect him to make a few passes in the air and produce music. He was an earnest little man of about thirty-five, who seemed to make up in his pathetic eagerness to please what he lacked in a sense of humor. His only electrical experience before he bought his own set, had been the repairing on an occasional bell circuit. Once, when he had spent half of a Saturday afternoon under his dining-room table and in

"IT SEEMED TO BE ALL SET, BUT NO RECEIVING"

the pantry, trying to determine why the buzzer wouldn't work, and had finally thought of exchanging the old dry cells for new ones, and had done it—with amazing and complete success—his wife and some of her women friends had marveled, and had called him "awfully clever at that kind of thing." And when he had done a similar trick with his radio set, and even remedied a couple of more serious ills such as replacing a burnt-out tube, he began to believe they were right. At any rate, the Nutmegs and their guests would think he was "awfully clever at that kind of thing" unless he proved himself otherwise; and he saw no reason to hasten a show-down. Besides, he had plenty of confidence that he could do the job. It wasn't as if he didn't know a rheostat from a loop antenna; he had picked up a lot in three months. So he walked over to the table and looked at the Nutmegs' receiver. It wasn't at all like his: it had twice as many tubes and half again as many dials.

However, most sets are essentially the same. He looked at Brainley and Jack in their shirt-sleeves. "May I?" he asked of Mrs. Nutmeg.

"Oh, of course! Here, let me take your coat."

Off came Mr. Flash's coat and up went his sleeves. Then he planted himself in front of the set with Brainley on one side of him and Jack Mabie on the other, and the others giving him their undivided and confident attention in the background.

"WE MIGHT as well begin at the beginning and go right through," he said briskly, for once in his life feeling the thrill of being master of a situation. "Antenna's all right, I suppose? Well insulated? Not touching the side of the house? Between 75 and 150 feet long? Hmm!" He looked at the knife switch on the window-sill, to which Brainley had dutifully connected the lead-in and ground, as per directions. "That seems to be as it should. Now the ground—hmm!—radiator—ground clamp. Tight? Yes. Now the B battery."

Here *was* talent! Everyone perked up considerably, filled with admiration and with renewed hope of having some music after all. Mr. Flash had the air of a doctor who says: "Pulse, normal; temperature, normal. . . ."

"Have you a B-battery voltmeter?"

Brainley was sorry to say that he didn't know what one looked like.

"Well, never mind; they're new batteries, aren't they?"

"Yes. Brand new."

"Hmm! A-battery? Newly charged?"

"I think so. It came from the store with the rest of the stuff."

The radio expert twirled a nut off one of the A-battery binding posts in the rear of the set, losing the nut on the floor. He touched the end of the wire to the other post of the battery. Spat! Spat! All kinds of fireworks. "Juice there," he said calmly. His audience looked on in rapture.

"Are you sure the polarity's right?"

"The what?"

Mr. Flash descended to a term more intelligible to the uninitiated. "Are you sure that the wire going to the plus A on the set is attached to the positive, and not the negative side of the battery?"

"I think so. The directions said the positive dingus generally had a swipe of red paint on it."

"Sometimes the battery people make a mistake," said Mr. Flash, indulging in this flight of fancy so as to pave the way for a spectacular effect that suddenly occurred to him. "Now if we only had a potato—a raw potato—we could easily tell."

"A raw potato?"

Mr. Flash seemed to be rapidly becoming inebriated with the wine of rapt attention that everyone was giving him. "Yes. You put the terminals into it, and a black ring appears around the positive one."

Magic! Mrs. Nutmeg started out to the kitchen to get a potato.

But Mr. Flash had spoken before he had thought. He wasn't sure whether it was the positive or the negative terminal which discolored the potato. "Never mind!" he called. "There's an easier way. We'll consider the red positive, and if the set doesn't work that way we'll reverse the connections."

All the others, even Grandma Muscadier, looked disappointed that they weren't to be shown what happens to the potato. Brainley resolved to try the experiment himself, sometime, when nobody was around.

"NOW the vacuum tubes," went on the monarch-of-all-he-surveyed. He waggled the rheostats back and forth. "All four of them light. Now for the connections."

Jack Mabie picked up the direction sheet which had fallen to the floor, and offered it to him. But he declined it, gently. "I think I can trace out the wiring just as well without it, thanks."

Extraordinary! The others looked at him

"THE MORE THEY LOOKED, THE MORE THEIR WONDER GREW
THAT ONE SMALL HEAD COULD CARRY ALL HE KNEW"

with even increased admiration. Brainley thought of the only two verses of poetry he remembered out of all he had read in school:

The more they looked, the more their wonder grew,
That one small head could carry all he knew.

And so the examination progressed, until all possibilities of bad or broken connections, and other troubles, had been disposed of. But still the set didn't speak a word. They reversed the A-battery connection. Nothing doing. They put it back the way it was. This was all gradually becoming a bit tiresome. The audience was not quite so breathless with interest, their eyes weren't glued quite so tightly as at first, upon the Last Straw.

"The trouble with a radio set," said Mr. Flash, finally; "is that one little defect puts the whole machine out of business."

"I guess we'd better give it up for to-night," said Brainley.

Mr. Flash shook his head in bewilderment. "It's beyond me," he confessed, in a tone that implied it was probably beyond any one else, too. "Everything's all ready: if we could only put our finger on the trouble, we ought to get a signal that could be heard out on the street."

"MAYBE the tubes don't make good contacts in the sockets," suggested Junior, who had appeared at one side of the table from nowhere in particular.

Mr. Flash was the only one who bothered to reply to this. "No, it can't be that," he said gently.

But Junior was not to be squelched so easily. "Well," he asserted stoutly, "maybe there's a grid contact or a plate contact that's bent so far down in the socket that it doesn't touch the prong on the end of the tube. That was what Joe Brown and I found was wrong with his set, last week."

His father was impatient. "No no—can't you see they all light?"

"*They would anyway*, if the filament prongs made contact."

A strained silence followed this announcement. *Would* they or *wouldn't* they? Brainley didn't know. Mr. Flash hurriedly said, with the air of one who is being polite to the child of the house:

"Well, we can soon see whether the tube contacts are at fault."

Action again! He took out all the tubes and fished around in the first socket with the tip of the screw-driver. There was a sputter, and he jerked his hand out as if a bee had stung it.

"What's that? What's the matter?" asked Brainley.

"Juice from the A battery," replied Mr. Flash, as calmly as he could. And he undid one of the connections at the A battery.

"I can't get under these contacts with a

"BECAUSE . . . MR. GRUNT IS SITTING UP IN MY ROOM . . . LISTENING TO THE PRIZE FIGHT"

screw-driver. I wonder if I could have a hair-pin?"

Mrs. Mabie said she hadn't been able to offer any advice, but that she could at least supply the hair-pin. She did, and Mr. Flash began hooking it under each one of the prongs, bending it up a little way.

"First a potato, now a hair-pin," murmured Mrs. Nutmeg to Mrs. Mabie. "They'll be asking us for a china egg next."

After a while, Mr. Flash gave back the hair-pin, somewhat the worse for wear, and replaced the tubes.

"Funny," said Brainley, leaning wearily over the cabinet. "Now the tubes don't even light. I thought we had been holding our own at least, but it seems as if we're going backwards."

"No, you forget the A-battery connection," said Mr. Flash, remembering it himself just in time to make the remark. Brainley bent down, attached the A-battery wire—and a blast of music filled the room! It was some woman singing.

"There it is!"

"Oh, good!"

"Good for you, Mr. Flash!" cried the women, coming up from the background to join the group round the set.

"Hooray!" yelled Junior.

Brainley was all smiles. "Now to tune it in just a bit better," he said. He stepped round more in front of the set, pushing Junior out of the way. In a few seconds the singer's voice was coming in as clear as could be.

Junior seemed to be somewhat disheartened at the treatment he had received, but Jack Mabie clapped him on the shoulder and gave him a sly wink that sent his spirits soaring again.

Then everybody sat down and listened to the singing. At the end of the piece, the announcer gave his call letters. It was a place some distance away. "What do you know about that? 150 miles right off the bat," exclaimed Brainley. They sat still and listened to the next selection. And the next. Marvelous thing, the radio! However, that woman hadn't much of a voice. . . .

Mrs. Mabie was scanning the evening paper. She didn't yet know how to turn directly to the page where the radio programs are, but she finally found them.

"You know—there's a prize fight on to-

night. Why, it's being broadcast by the station right in the city!"

"Yes, it's Kid McDuggin versus Bullethead Jones . . ." began Junior; but he was interrupted by cries of "Oh, do let's try and get it!" "That will be a lot better than the woman singing!" etc., from the others.

Mr. Flash and Brainley rose to the occasion, tuned out the 150-mile woman, and searched for the local station. But they didn't seem to strike the right combination, even with Mr. Flash turning the dials at the right of the panel while Brainley turned those at the left. They did get all kinds of shrieks and groans, however; at which Mrs. Nutmeg put her hands over her ears and said: "Brainley! For mercy sakes—stop those *awful* noises!"

Brainley stopped, and let Mr. Flash have all the knobs to himself. Soon a man's voice was heard, faintly.

"Bring him in! Bring him in!" called the others excitedly, as if advising an angler how to play a fish.

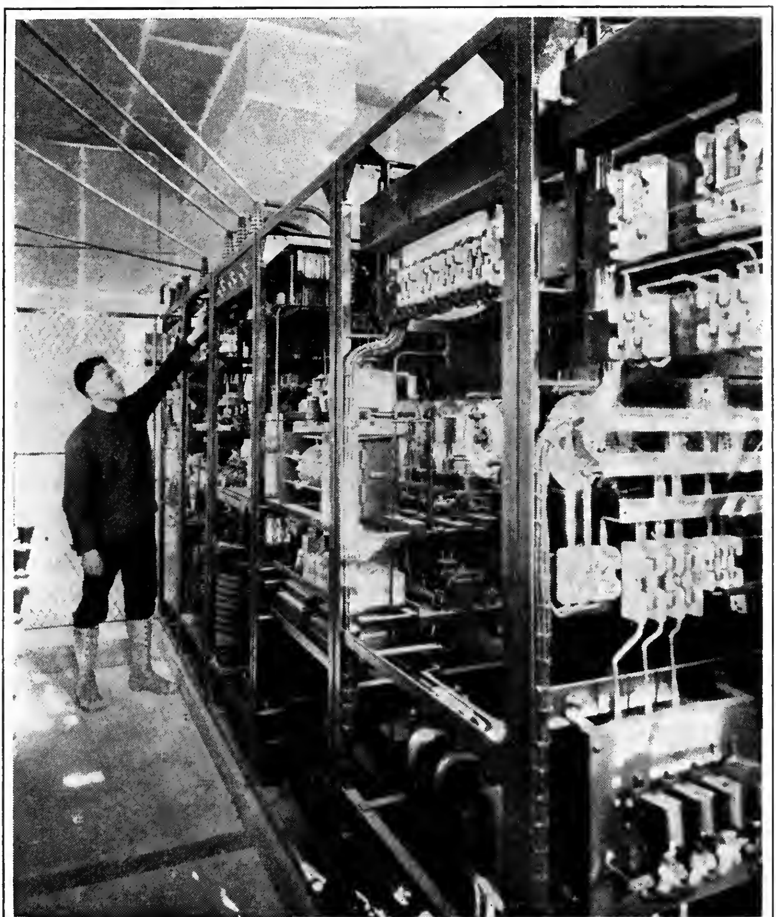
Mr. Flash brought him in. It was the announcer at the same 150-mile station, declaring that Miss Spairus was done for the evening.

"My goodness!" exclaimed Mrs. Nutmeg. "Junior, it's eleven o'clock. You ought to have been in bed long ago. Say good night to everyone, dear, and run along up. You can listen to the radio any night, now that it is working."

"But I *can't* go to bed yet", said Junior, earnestly.

"You can't? Why not?"

"Because—Mr. Grunt is up there sitting on my bed, listening to the prize fight."



WHAT A FIVE THOUSAND WATT BROADCASTING STATION LOOKS LIKE

From the unromantic side. The operator is shown behind the apparatus panel of the new WLW station at Harrison, Ohio, about twenty-five miles from Cincinnati where the studio is located. Operators in the Cincinnati studio control the station which is located far enough outside the city limits so that the powerful waves of the station will not mar the reception of the local enthusiasts

Progressive Experiment with the Roberts Circuit

BY KEITH HENNEY

THIS well-written and extremely enlightening article by Mr. Henney is distinctly not a construction article. The author is a new member of the technical staff of RADIO BROADCAST and has made one of his subjects for experiment in our laboratory, the Roberts circuit. We feel that there is room for a great deal of legitimate and productive experiment with this circuit, which has, as great numbers of radio folk will tell you, very large possibilities. Here Mr. Henney has carefully outlined the technical basis for his suggested experiments and shown why the changes he thinks desirable can be made. Those who have not yet built a Roberts Knockout receiver can do so and make the alterations recommended and those who already have one of them operating will unquestionably be interested in this line of technical thought. The author would be interested to hear from readers who follow in some of the paths here suggested.—THE EDITOR.

TO THOSE who enjoy radio for what it brings from the outer world, the "Knockout" series of receivers employing the Roberts circuit has much to offer. These may be built according to predetermined dimensions and specifications with the certainty that each one will work, or can be made to work. Building a receiver from the various articles about the Roberts circuit is like, let us say, making a cake according to an old established recipe.

On the other hand, there are many inquisitive mortals who enjoy radio *per se*, who like to build, and raze, and then rebuild. For these, the Roberts circuit has many avenues along which one might find something new.

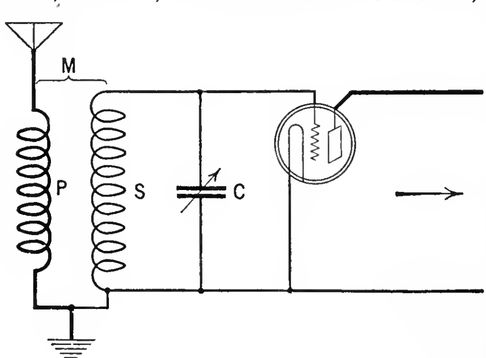


FIG. 1
The antenna-radio frequency amplifier circuit. The four variable elements in this circuit, the antenna coil, P, the secondary coil, S, the coupling, M, between these coils, and the secondary condenser C, are intimately connected with the operation of the receiver

The several Knockout receivers have been thoroughly described in RADIO BROADCAST and it is not for those who enjoy the completed receiver that this article is written. Rather, it is for those adventurous souls who would like to disprove the statement that there is nothing new under the sun.

Now to experiment efficiently is to experiment with some definite object in view; it is not to tear into the midst of things in the vain hope that somewhere along the line of destruction something interesting may turn up. One might forgive a surgeon who advised the removal of tonsils when one had a sore throat, but if he stumbled around and wanted to carve an appendix or the left middle finger for the same cause, it would be another matter.

The anatomy of the Roberts circuit should be well understood before the actual business of dissection and remodeling is begun. In general, the various sets of the Roberts Knockout series and the circuit upon which they are built is but one of several types of combined radio-frequency amplifiers and regenerative detectors. The Cutting and Washington Teledyne was one of the first commercial examples of this efficient combination. The High Mu receiver described by G. H. Browning in RADIO BROADCAST for December, 1924, was another method of doing about the same thing. All of these combine two prominent patented ideas, that of regeneration

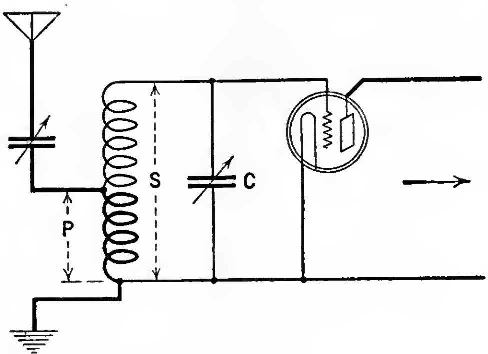


FIG. 2

The series condenser method of connecting the antenna to the amplifier. Once the proper place to tap the coil and the size of the condenser are found, the tuning will be practically independent of the antenna and will be very sharp

and that of neutralization of capacity feedback between the circuits.

The only excuse for these suggested experiments with the Knockout Roberts circuit is to make it better—if possible. There are two points of attack: the amplifier and the detector. Tuning may be made sharper and signals may be made stronger. Both of these are worthy improvements. Another improvement would be a simplification of the tuning; the elimination of the taps and the antenna coil.

THE RADIO FREQUENCY AMPLIFIER

BEGINNING with the amplifier, then, let us see what it consists of and where we might find a point of attack. Fig. 1 shows the conventional arrangement of coils, condenser, and tube. Evidently there are four variable factors:

1. Primary or antenna coil, P.
2. Coupling of primary and secondary coils, M.
3. Secondary or grid coil, S.
4. Secondary tuning condenser, C.

Now the size of the secondary coil and its tuning condenser are intimately related to the wavelengths to be received. We may increase the number of turns on the coil and decrease the number of plates on the condenser, or vice versa. When we increase factor 3 (in the list above), we must decrease factor 4. One has the certainty, however, that better results will always be obtained with the largest practical coil and the smallest practical condenser. The use of a small condenser is advisable because of the fact that a variable capacity has a high resistance near the low end of its scale.

Any one of the orthodox fifteen or seventeen plate condensers of the "low-loss" variety, that is, a condenser of about .00035 microfarads capacity, will cover the broadcasting wavelength range nicely provided the coil used with it is made properly.

The size of wire and the method of winding are variables also, but until more is known definitely about the importance of these variables it is safe to leave them out of consideration. It has been demonstrated that it is unwise to go to extremes in the matter of size of wire, say larger than No. 18 or smaller than No. 28. At the present time it seems that any of the methods of winding are effective, say the single layer coil, the spider web or the basket weave. The main thing is to see that there are no short circuited turns, and to avoid all forms of "stickem," except an occasional dab of collodion.

The size of the antenna coil and its coupling to the secondary control the sharpness of tuning of this amplifier circuit, and to some extent govern the strength of signals. If the coil is too close or too large, the high resistance of the antenna will be reflected into the grid circuit and will make tuning broad. If the coils are too far apart not enough voltage will be impressed from the antenna circuit and signals will not be as strong as they might be.

A solution to this matter seems to lie in an arrangement attributed to the English circuit wizard, Scott-Taggart. The method is illustrated in Fig. 2 and is quite simple. Instead of using a distinct coil and feeding in the voltage by electromagnetic coupling, the voltage is introduced directly into the secondary circuit by means of a small series condenser. One of the small vernier types, external to the average condenser itself, will

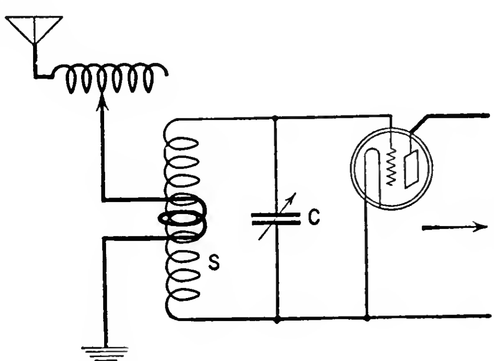


FIG. 3

The series inductance method of tuning the antenna circuit. For each wavelength there is a particular tap and value of the secondary tuning condenser that will give maximum volume and selectivity

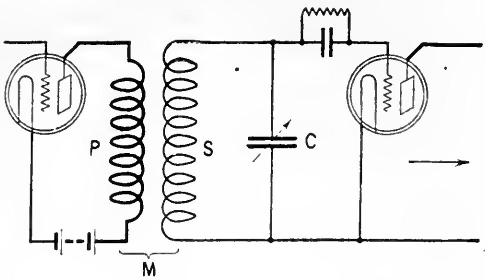


FIG. 4

The radio-frequency transformer. Here again are four variables. Instead of an antenna coil as in Fig. 1 three is a plate coil which serves the same purpose—that of transferring the voltage from one part of the circuit to another. The coupling, M, must be close if the longer wavelength stations are to be heard

do very well, and if one wishes, a fixed condenser, say of .0001 mfd. may be used, and the coil then tapped at two or three places.

The antenna-ground circuit in this case is completed by attaching the ground to the bottom of the coil. If too many turns are included in this antenna circuit, tuning will be broad, but with the proper juggling, a position will be found where the tuning is practically independent of antenna size, and the other taps may be discarded.

Another method is shown in Fig. 3 but is open to the objection that an additional tuning control is necessary. The plate in Fig. 9 shows this arrangement. The antenna coil is tapped but its adjustment is not critical.

For simplicity, the series condenser method seems best. It eliminates one coil and the taps of the Roberts Knockout receivers, and makes the tuning of the amplifier sharper without decreasing the strength of signals. In fact, separating the antenna from the grid circuit by this isolating condenser tends to decrease the resistance of this circuit so that stronger signals frequently result.

THE RADIO FREQUENCY TRANSFORMER

TACKLING the radio-frequency transformer is like experimenting with dynamite. Something is bound to happen, but when or what are unknowns.

In this case the same variables exist. Fig. 4 shows the simplified diagram of this transformer.

Here again the size of the secondary coil and its condenser are controlled by the wavelengths to be received, and the condenser should not be larger than necessary. If the two tuning condensers of the set are alike it is always possible to adjust the number of turns on the coils so that the dials will read alike for any particular station.

The primary may vary from one turn to as many as one wishes but with various results. The usual commercial neutrodyne uses about ten turns or less, which are scarcely enough to get full gain out of the amplifier. Five-tube sets which are not manufactured under Hazeltine licenses use fewer turns on the primary so that there is little danger of the amplifier oscillating.

The effect of varying the ratio between the primary and secondary turns is not so obvious as it may seem. In low frequency circuits, the voltage across the secondary of a transformer depends directly on the turn ratio, but this is not the case in high frequency circuits. Because of this there is no reason in trying for a high "step-up" by cutting down the primary and increasing the secondary turns.

Too few turns will not transfer enough voltage from the plate circuit, especially at the longer wavelengths. Too many turns distort the amplifier characteristic so that the low wavelength stations are slighted. And without complicated laboratory equipment the experimenter is not able to find the correct ratio of turns except by cut and try. The best ratio is the one that brings in stations about the middle of the broadcasting range loudest, say those around 360 meters.

In the Knockout spider web coils the primary has 22 turns. In the High Mu receiver there are 26 turns—both being at least twice the number on most commercial neutrodynes. With many turns in the plate circuit of the amplifier tube the tendency toward oscillation is greater, and more care must be exercised in arranging the apparatus to eliminate feed-

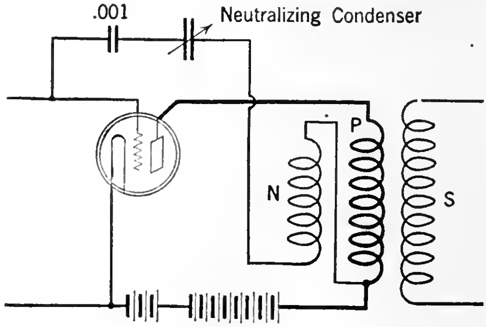


FIG. 5

A method of protecting tubes in case the neutralizing condenser becomes shorted. The additional condenser may be of any size provided it is larger than the neutralizing capacity

back. On the other hand, the amplifier with 20 turns in the plate circuit will perform better as an amplifier once it is properly neutralized, and the long wavelength stations will receive their amplification.

The matter of coupling between the two coils of the radio-frequency transformer is important, and the inability of many receivers to pick up the longer wave stations lies in neglect of this important point. To get maximum voltage transfer, maximum coupling must exist between primary and secondary. This coupling must be electromagnetic, and electrostatic coupling must be reduced to a minimum. The High Mu receiver already mentioned employs an interesting method of eliminating capacity coupling, and to some extent the receiver illustrated here does the same.

The primary is a typical Knockout affair—two wires simultaneously wound into a compact coil. It has recently been found that greater ease in neutralizing will be obtained if the two wires are twisted together before winding. This may be done by placing two ends of the wires in a vise or some other support and twisting the wires together by means of a small hand drill.

The secondary should be as close to the primary as possible but without actual overlapping of wires, which has the effect of shorting several of the secondary turns with resultant broadness of tuning. Loosening the coupling between the coils is often useful in eliminating unwanted signals, but to get maximum voltage from the amplifier to the detector the two windings would be close together. Fig. 10 shows one method of making the coupling variable.

NEUTRALIZING METHODS

THE neutralizing condenser must be somewhat larger than the ordinary and care must be taken that it does not "short" for that would place the B battery voltage across the filaments. One method of preventing loss of tubes from this cause is shown in Fig. 5. A large condenser, say .001 mfd., is placed in series with the neutralizing condenser.

Since the Knockout is a reflex arrangement, the usual method of balancing out the capacity feed back with the amplifier tube unlighted is impossible. One method is to listen with the phones in the amplifier as usual and to tune the two circuits to the same wavelength. If the amplifier is any good at all it will oscillate, a phenomenon that is easily recognized. Then the neutralizing condenser may be adjusted until oscillations cease. It will be found that the adjustment is somewhat critical and increasing the capacity beyond the required point will cause the amplifier to oscillate

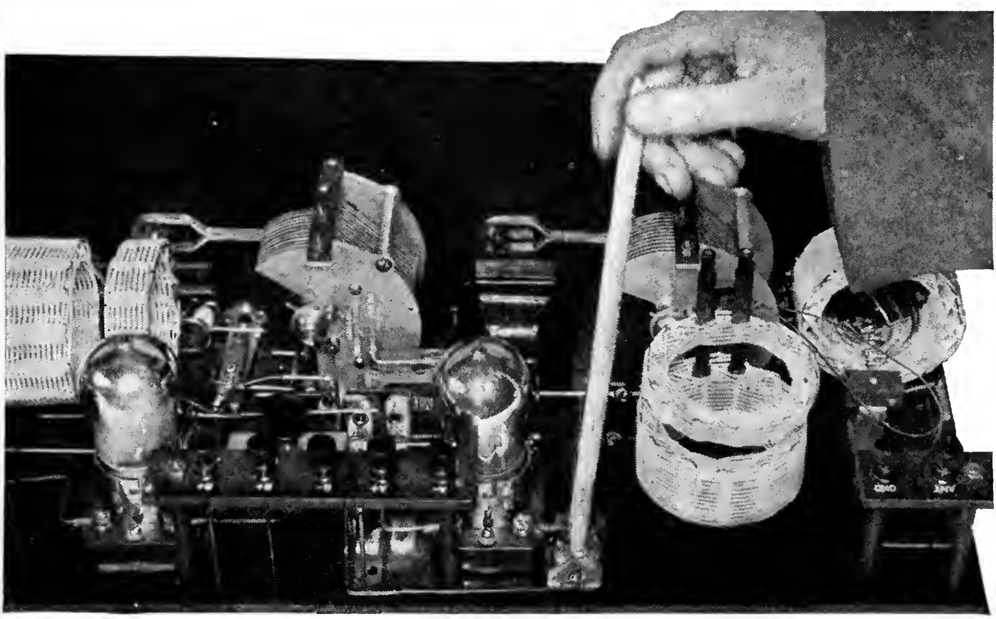


FIG. 6

A photograph of a convenient neutralizing condenser which may be adjusted as the photograph shows, so that the operator's hand does not come near enough to cause bad capacity effects

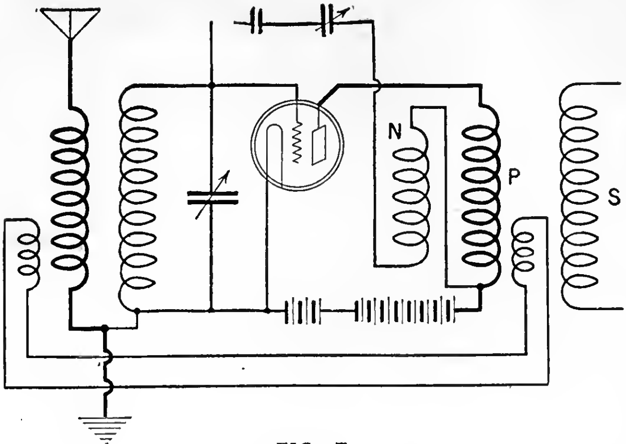


FIG. 7

A stunt for the "DX" seeker. The sizes of the coils that convey some voltage from the antenna directly to the detector and the coupling to their respective circuits must be determined by experiment. Interesting results have been obtained in preliminary trials of this scheme

again which results in effect, in a miniature Hartley circuit. In this method the tickler should be shorted, or at least turned to minimum coupling with the secondary so that the detector circuit does not oscillate.

Another method is actually to make the detector oscillate, and to tune to some carrier wave. Then the neutralizing condenser may be adjusted until the carrier wave does not change in pitch when the amplifier tuning condenser is varied.

A particularly useful neutralizing condenser is shown in Fig. 6. This may be adjusted with a stick whittled into the shape of a screw driver, eliminating the bad capacity effect of bringing the hand near the condenser itself.

THE SECONDARY WINDING

THE secondary winding should always be as large as possible with the condenser that is used. For the experimenter who winds his own coils, the correct number may be found by putting on too many to begin with. Then the longest wavelength station that is to be received is tuned in, and the coil reduced in size, one turn at a time, until the station is tuned near the top of the condenser scale.

The end of the winding near the primary goes to the filament and the other to the grid. With some tubes it is better to connect the coil to the negative filament lead instead of the more usual connection to the positive. The proper polarity may best be determined by experiment.

A SUGGESTION WITH POSSIBILITIES

FOR the dyed-in-the-wool experimenter, a new scheme has been suggested for boosting signal strength. Fig. 7 illustrates

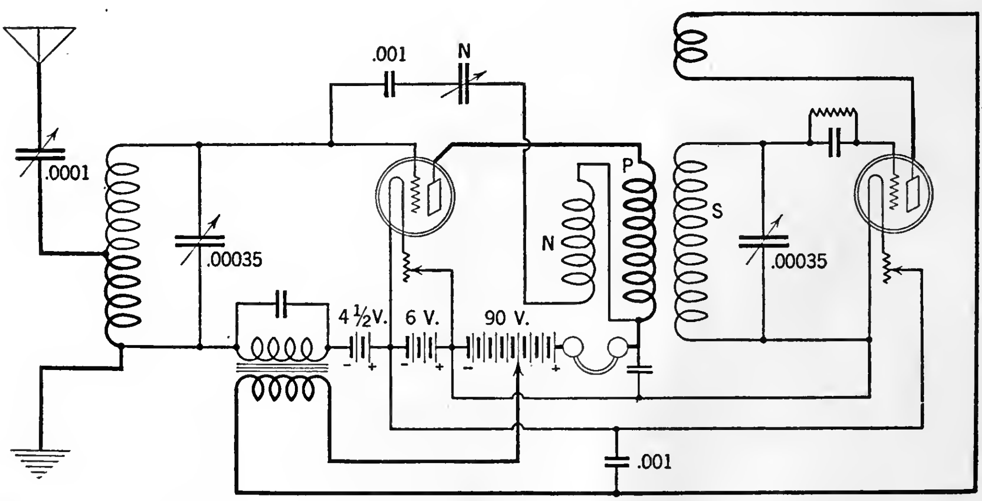


FIG. 8

The complete Roberts circuit. If condensers of other capacity than the .00035 mfd. shown here are used, corresponding changes will have to be made in the secondary coils. The fixed condenser across the phones in the amplifier should be about .001 mfd. and that across the secondary of the reflexed transformer as small as possible

this stunt in symbolic manner. A few turns from the antenna are placed near the primary of the radio frequency coil, with the object of feeding some of the antenna voltage directly into the detector circuit. In preliminary experiments on this modification in the Radio Broadcast Laboratory, some interesting results were obtained, but definite information as to the proper number of turns and coupling is not yet ready.

BY-PASS CONDENSERS

IN ALL reflex circuits the by-pass condensers are important items. Across the primary of the audio frequency transformer is a condenser to pass the radio frequencies around this high impedance coil. Unless this condenser is large enough, the detector circuit will not oscillate. On the other hand the condenser must not be too large or some of the high audio frequencies, say those of the piccolo or higher violin harmonics, will not be heard. This statement applies to all condensers that are used around audio-frequency transformers. The muffled tones that are often heard are due to oversize condensers.

The condenser across the secondary as shown in Fig. 8 should be as small as possible, for a small capacity here has the same effect as a large one across the primary. The experimenter should begin with the smallest condenser available, as say, .0001 mfd. and increase its value slowly until full gain is secured from the amplifier.

Another scheme that may be used is to use a grid leak across the secondary instead of a condenser. Its value is best determined by trial.

OTHER VARIABLE ELEMENTS IN THIS CIRCUIT

THE photograph in Fig. 9 shows the use of a variable grid leak—The Fil-Ko-Leak—that is very useful. This has any value up to and including 6 megohms, a range that is practical for any of the tubes now obtainable. For some tubes the value is quite critical and the simplicity of obtaining the required resistance appeals at once to the experimenter and the one who wants to adjust his receiver to the top notch of efficiency, and to leave it there.

In the original Roberts Knockout receiver, a voltage of 45 was recommended for the detector, a value which gives the maximum signal strength with average tubes. Tubes, however, are not all alike—would that they were! —and what is sauce for the goose is not always sauce for the gander. Too much B battery on the detector makes the tickler function irregularly and the detector too difficult to control. Too little B battery and the detector circuit refuses to oscillate at all. The correct value may lie anywhere between $16\frac{1}{2}$ volts to above 45. The only approved method of discovering that elusive value is by experiment.

Connecting the negative B battery lead to the negative A battery gives a reduction of approximately 6 volts (with storage battery tubes) in the voltage to the detector, and is one method of adjusting this variable.

The photograph in Fig. 9 shows a set in which all the variables are present. The antenna coupling to the amplifier, the primary and secondary of the radio frequency transformer, the grid leak of the detector, the

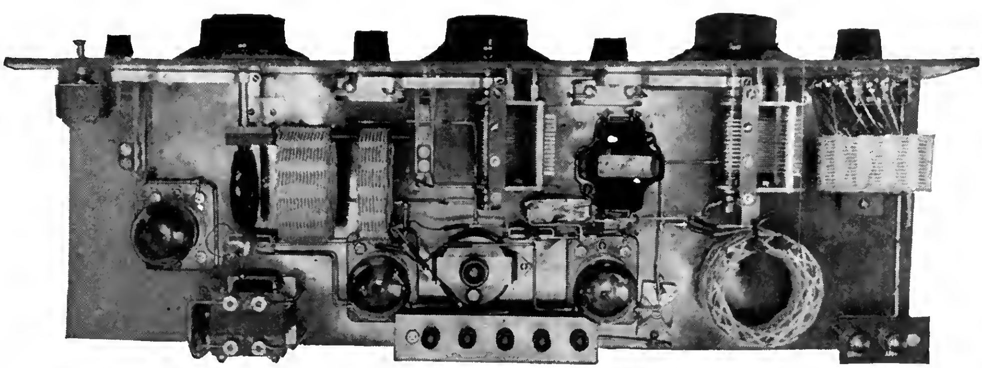


FIG. 9

A photograph of a receiver that is a veritable experimenter's paradise—everything is variable. The method of changing the coupling between the antenna coil and the amplifier as well as the series inductance method of tuning the antenna circuit is shown here. A variable grid leak may be seen near the binding posts. In this case the value was 2 megohms. The variable resistance was calibrated and was remarkably accurate for an instrument of its small size

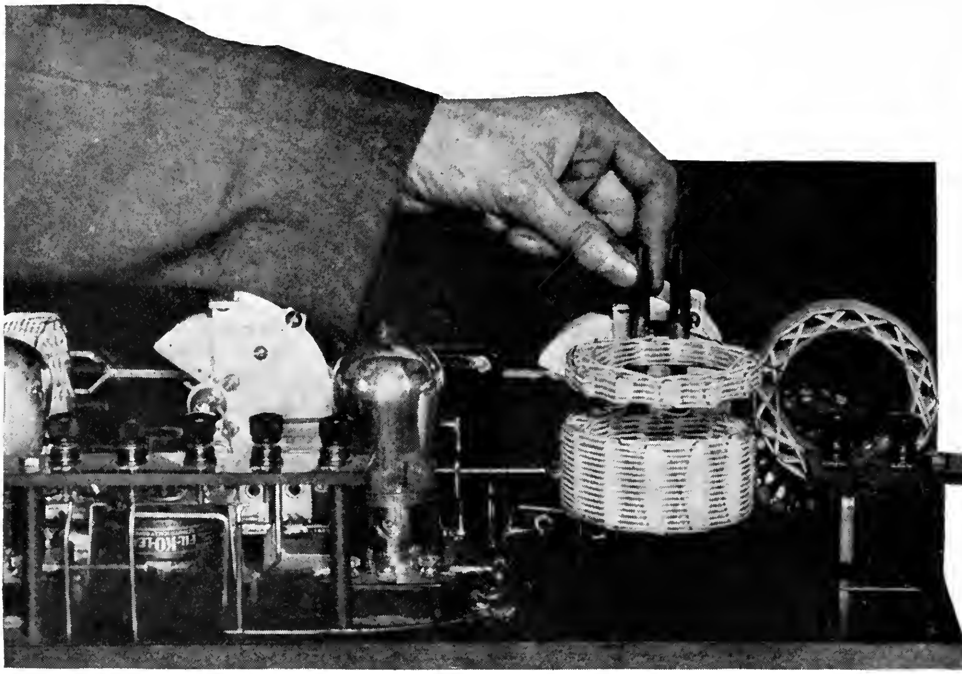


FIG. 10

The variable coupling between the primary and secondary of the antenna coupling coil is interesting to the experimenter. For selectivity the coupling should be loose, but when longer wavelength stations are received the two coils should be as close together as possible

neutralizing condenser—all are variable, a rather complicated state of affairs but one in which the experimentally inclined may be sure of getting the maximum results at all times.

There is another variable factor that has been discussed in recent radio articles, and that is the effect B battery voltage has on the radio frequency amplifier. The point has been raised that there is no use in placing full 90 volts on the tube of this amplifier, since there is no necessity for power amplification here but only for voltage step-up. The idea is that with decreased plate voltage, the current drain from the B batteries would be correspondingly decreased, which tends toward greater economy.

Unfortunately another point enters here that the uninitiated does not seem to know. We refer to vacuum tube operation and the mathematics of radio-frequency amplifiers. The facts are these: The voltage amplification produced by this tube depends inversely upon the plate impedance of the tube. The impedance in turn depends inversely upon the plate voltage.

In other words, the greater the plate voltage, the lower the plate impedance, and the greater will be the amplification. The drain from the B batteries may be kept down to the proper limits by the judicious use of C batteries. The fact that the Roberts Knockout is a reflex circuit in which audio frequency currents are also flowing in the plate circuit of the first tube makes even more important the matter of proper B and C voltages on this tube.

It is a distinct advantage in the Knockout receiver to use as high plate voltages as possible and at the same time to keep down the B battery drain by means of C batteries. Ninety volts is none too much to use on the amplifiers, even 125 may be used provided the proper care is taken. As much C battery as possible should be employed consistent with good quality and good volume. It will be found that the C battery is very important, better signals always being secured when this voltage is correctly adjusted.

Standard apparatus was used throughout this receiver. The first transformer is a General Radio No. 285 and the second, a No. 65A Federal. The condensers are Gardner and Hepburn. The coils are "Supercoils" made by the Perfection Radio Manufacturing Company.

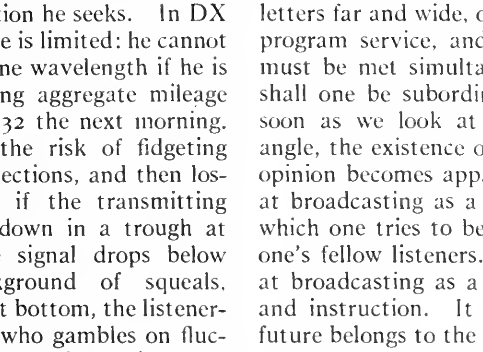
As the Broadcaster Sees It

By CARL DREHER

Drawings by Franklyn Stratford

Should Broadcasters Serve Local or Distant Listeners?

ONE of our readers, Mr. A. R. Cochran of Chester, Pennsylvania, complains of the difficulty encountered by distance hunters when they come across a station which does not announce its call letters at frequent intervals. The receiver being painstakingly tuned to the distant signal, the listener waits breathlessly for the end of a number, only to have the music start again without any announcement to give him the information he seeks. In DX fishing, the listener's time is limited: he cannot linger too long on any one wavelength if he is to grind out an imposing aggregate mileage to brag about on the 7.32 the next morning. Furthermore, he runs the risk of fidgeting through a number of selections, and then losing the announcement if the transmitting station happens to be down in a trough at that moment, and the signal drops below the omnipresent background of squeals, static, and induction. At bottom, the listener-for-distance is a person who gambles on fluctuations of signal strength against noise—and the noise is always present if one amplifies enough. Naturally, therefore, this class of listener feels aggrieved when the broadcaster does not coöperate with him by frequent emission of his call letters. He wants more. As every user of the telephone knows, some of the letters of the alphabet, like C, B, and D, are easily confused. The vowel component is the same in each case, and the consonant is apt to be lost in the shuffle. Mr. Cochran accordingly revives the proposal to assign names to the letters, a procedure which has found successful application in various methods of code signalling. "WGY" would be announced as "Watch George Yoke." "Watch Boy Able Pup," it is pointed out, could not be confused with "Watch Pup Able Boy," as readily as WBAP may be read for WPAB.



fishing for radio distance

This is all very logical, but immediately the question arises: Is it the purpose of a broadcasting station merely to distribute its call letters far and wide, or is it its object to give a program service, and if both these demands must be met simultaneously, to what extent shall one be subordinated to the other? As soon as we look at the question from this angle, the existence of two opposing bodies of opinion becomes apparent. One school looks at broadcasting as a game or competition in which one tries to beat out the elements and one's fellow listeners. The other party looks at broadcasting as a source of entertainment and instruction. It is my opinion that the future belongs to the party of the second part However, let us proceed to a discussion of the question from both sides.

What does the DX hound get out of his hobby? First, the thrill of annihilating distance, in a certain sense. There is a kind of Olympian triumph in listening to sounds coming from the other side of the continent. Secondly, there is the zest of competition. Not everyone can get distant stations. Here we have the I-can-take-any-hill-on-high psychology. In early youth, it's "My big brother can lick your big brother." But it is quite human at any age, and not

everyone can shoot tigers in India, or climb Mt. McKinley, or explore the polar regions. Such epic feats require space and money, and who will begrudge the denizens of city apartment houses, possessing none too much of either, getting what throb they can out of their radio sets? Thirdly, if one builds one's own set, or studies the operation of receivers, whether factory- or home-made, there is an element of technological education. There may be other factors besides these three and their corollaries, but I believe that most of the impulses behind the DX game may be classified as above.

To a disinterested witness, DX fishing seems about the same sort of thing as the feat of a graduate student at Columbia in writing six hundred words on the back of a postage stamp. It wasn't useful. It wasn't salubrious. It didn't make old Henry Barnard lean over the ramparts of heaven to applaud the scholarly achievement of this student of his university. The words that were written may have been worth reading, but one would go to a book to read them, not to a postage stamp. All one can say for the feat is that it amused that particular young man, that it quickened the sense of living in him. That is about all that one can say about DX reception. Perhaps that is a good deal. At the worst, *De gustibus non est disputandum*, or, in other words, Let everyone go to——Ahem—— in his own way.

That is all there is to be said from a personal standpoint, but something may be said in the interest of the program directors. I am an engineer, not a program man, but I know enough of the problems of these harassed pioneers, whose work will probably be appreciated at its worth when they are dead, to give what I am sure would be their reaction to the proposal to use code words in place of letters. The letters themselves have no program value, but at least they are meaningless and innocuous. In the show business—and broadcasting is a branch of the show business, let it never be forgotten—it is only a short step from the sublime to the ridiculous. Nor does one like to risk annoying the audience by any conspicuous repetition of the commonplace. "Watch George Yoke," dinned too often into the ears of the Schenectady populace, might cause distressing reactions. It would not be a very fitting termination for the "Marche Slav." It would not be a romantic interlude between dances with a beautiful girl. If I had anything to do with running off WGY's program I should boggle at "Watch George Yoke," and take my chances with the wrath of the listeners in Lower California.

Is it at all certain that call letters or arbitrary designations will continue to be used for identification of broadcasting stations? Are not these symbols a vestigial left-over from the purely telegraph days of radio? Would one assign call letters to the Odéon of Paris, or to Covent Gardens, or to the Metropolitan Opera? The day will come when broadcasting stations—some of them, at any rate—will be on this artistic level, and, as a matter of course, their programs will be heard all over the world. Then where will be the thrill of hearing distant stations? When everyone can do it, there will be no fun in it. There will be no more use for call letters when radio arrives at that stage than there would be for tree-blazes in a city park.

Furthermore, the urge to hear and be heard over thousands of miles leads to a frame of mind at least indirectly opposed to sound program considerations. As this article is written, a St. Louis station announces that on a certain day it is going to broadcast continuously for eighteen hours, in the expectation of being heard all over the world. Have they made certain that they are going to have something to say which should be heard all over the world? Eighteen hours is a long stretch. How much of the eighteen-hour output is going to be worth hearing? Would it not be just as well to have an automatic machine sending, "The quick brown fox jumped over the lazy dog," and signing the call letters every four seconds? Best of all, why not go the whole hog, simply repeat the call letters interminably, and let it go at that?

In building up this *reductio ad absurdum*, and in presenting the various aspects of this question as they appear to me, I have no desire to be dogmatic. I do not assume the powers of an arbiter for 500-odd broadcasters and heaven knows how many million listeners. Has anyone else something to contribute to the symposium?

How Many Radio Receivers Are There?

UNDER the direction of Borough President Connolly, a radio canvass was recently made in Queens, New York City, and a total of 34,994 receiving sets was found. Queens has a population of 470,000. Assuming that the canvass was accurately carried out, it would appear that in this locality there is one radio set to about 13.5

of population. With this figure as a starting point some approximations may be made as to the actual number of radio receivers in use in the United States.

Queens is a part of New York City, but, next to Richmond, it is the most sparsely settled of the five boroughs. The density of population is about 4,343 to the square mile. Richmond has 2,050 to the square mile; the Bronx, 17,900; Kings, 28,500; New York County (Manhattan) averages no less than 103,900 to the square mile. These figures are from the 1920 census. The great variation in the degree of urbanization and the density of population, even within the borders of New York City, is quite apparent.

If we assume that the inhabitants of other parts of New York City have gone in for radio to the same extent as those of Queens (one set to 13.5 persons), then, the population of New York City being about 5,623,500, there must be some 420,000 receivers within the city limits—say 450,000 to allow for the increase in population since 1920. Taking the population of the metropolitan district, comprising New York City, Westchester County in New York State, and most of seven adjacent counties in New Jersey, as about 8,000,000, there must be some 600,000 sets in this district.

On the basis of 100,000,000 as the population of the United States, half of the population being classified as urban, at the rate of one set to 14 persons, this section of the citizenry has absorbed some 3,500,000 receivers. In the remaining rural portion probably the percentage of receivers to the population is not over a quarter of the ratio disclosed in the Queens census: This would amount to 900,000 sets in rural territory, or a total of 4,400,000 for the entire country. This figure agrees fairly well with the conjectural totals of 3,500,000 to 5,000,000 receivers in the United States which have been offered by various estimators.

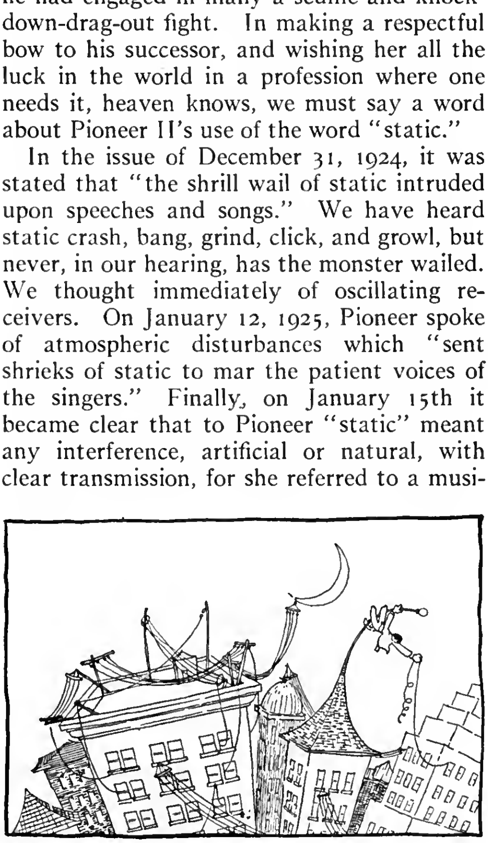
The writer is just enough of a statistician to insist that his results are not accurate to better than 25 per cent. high or low. Those who are booming radio will add the 25 per cent. and those very vocal gentlemen who insist that radio is ruining the theater, the varnished pretzel industry, etc., have the privilege of subtracting 25 per cent. if it will make them feel better.

If a radio census could be carried out in several rural counties a more accurate estimate of the number of radio sets in the country would be possible. The weakness of the above estimates lies in the fact that they are based on a ratio obtained in one urban locality. The average density of population in New York State is only about 220 per mile, or about one twentieth of the density in Queens. In Nassau County on Long Island the figure is 460 per mile, while in Hamilton County it is 2.3 per mile, which is close to the figure of 1.0 per square mile taken as frontier population in political economy. If reliable figures on the number of radio sets in representative counties like Erie, Ulster, and Suffolk could be obtained, a reasonably accurate total for New York State could be calculated, and this might be adapted to other states.

"Pioneer's" Static

THE New York *Herald-Tribune* runs a daily column of radio criticism, "Last Night on the Radio," by "Pioneer." Recently the first "Pioneer" departed, not, we are happy to say, from the earth, but merely from the lists of broadcasting comment, where he had engaged in many a scuffle and knock-down-drag-out fight. In making a respectful bow to his successor, and wishing her all the luck in the world in a profession where one needs it, heaven knows, we must say a word about Pioneer II's use of the word "static."

In the issue of December 31, 1924, it was stated that "the shrill wail of static intruded upon speeches and songs." We have heard static crash, bang, grind, click, and growl, but never, in our hearing, has the monster wailed. We thought immediately of oscillating receivers. On January 12, 1925, Pioneer spoke of atmospheric disturbances which "sent shrieks of static to mar the patient voices of the singers." Finally, on January 15th it became clear that to Pioneer "static" meant any interference, artificial or natural, with clear transmission, for she referred to a musi-



one radio for every 13½ citizens

cal feature "transmitted to that slight whistling accompaniment of static which we have noticed of late from——." Incidental comments were "overwhelmed in the rush of static noises." "This defect in transmission is due," we were told, "to some malady of the . . . microphone . . . "

"Static," in orthodox engineering terminology, is applied only to disturbances arising from electrostatic charges accumulating on a receiving antenna. "Strays" is the proper name for other natural disturbances with reception, generally originating in local or distant lightning. However, both static and strays are loosely grouped under the single term "static." This word is never properly applied to man-made disturbances. It was so used in a series excellent articles in RADIO BROADCAST on inductive disturbances by Mr. A. F. Van Dyck, but purely as a figure of speech. "Heterodyning," "squealing," "howling," "induction," "line noise," "cross-talk," "crossfire," "oscillation," "commutator ripple," "tube hiss," are a few of the names applied to various forms of artificial disturbance. To the expert, every little noise has a meaning of its own.

It is quite possible that technical radio terminology will diverge from the popular lingo much as in medicine and other fields. The man in the street talks of his "breastbone," where the physician uses "sternum"; be speaks of an "ear-inflammation" where the professional medical man refers to "acute otitis media." As often as not the popular term means the same as the more esoteric technical expression; frequently, however, the latter has the advantage in definiteness and accuracy. The technical nomenclature is valuable, in another respect, it enables the technician to feel superior to the layman, and to write articles like this one.

the radio critics are here to stay

Molly and the Paint

OUR estimable neighbor, Miss Mix, in "The Listeners' Point of View" for February, cites a WGY program in which a waltz, "Take a Look at Molly," is followed by a lecture on "The Metallography of Paint," after which appears the fox trot, "Jealous." Miss Mix then inquires whether anyone but the compiler of this program knows why a talk was put in such a place; she suggests, furthermore, that the compiler himself may not know.

In the course of our scientific investigations we have on many occasions found it necessary to inspect the lips, cheeks, and eyebrows of beautiful girls at close range. None of them was named Molly. All of them, if we may set it down without betraying confidences, enhanced their loveliness with various daubs and pigments. May it not be that the WGY program wrestler, looking at some Mary or Minnie or Molly in the office, had his mind driven, by an irresistible and logical association of ideas, to the subject of paint?

More Data on the Differentiation of Broadcasting Stations

THE New York *Times* of January 15th carries a news item stating that the Paulist Fathers are installing a 500-watt broadcasting station at their headquarters on 59th Street, the programs to include concerts by the Paulist Choristers, lectures by well-known Catholics, both clergymen and laymen, and instruction in the principles of the Roman Catholic church. Of course this is not the first broadcasting station to be operated by a religious organization, WQAO of the Calvary Baptist Church, and WBBR of the People's Pulpit Association being local predecessors in this field. The new station, whose call letters are to be WPL, is perhaps the first major broadcasting venture of the Catholic church in this country: the evangelical creeds, in general, have been less conservative.

Religious broadcasters are existing examples of specialization in radio program material. In the nature of the case they are limited to serious music and discussions. Jazz and humor have no place on their programs. Their object is to edify, not to amuse. At present practically all the New York stations, even the distinctively jazzy Let's-go-boys type, carry some sermonic or sacred material. In time, perhaps, this class of broadcasting will be taken over largely by specialists.

An SOS Log

IN OUR previous disquisition on the subject of "Broadcasting and the sos" we made the statement that the inland broadcasters, under the present system, do not pay much attention to sos calls on the high seas. We now present in substantiation our log of January 1, 1925, taken in New York City. We did not listen on wavelengths below 450 meters. The deleted entries represent radio telegraph traffic which we are not at liberty to divulge.

January 1, 1925.

12.30 A.M.	QRT SOS NAH New York broadcasters go off air.
12.32	WHO Des Moines, Iowa, broadcasting. 522.3 meters.
12.33	————
12.42	WCX Detroit, Mich., 516 meters. Broadcasting jazz—"Follow the Swallow," etc.
12.44	WOC Davenport, Iowa. "What'll I Do?" and other dance numbers. 498 meters.
12.45	————
12.47	KYW Chicago, 535.4 meters. Someone broadcasting request messages and smart patter. Says it's 10 minutes to 12.
12.49	————
12.50	————
12.56	WCAE Pittsburgh. Dance music Silvertown orchestra from New York by wire. 462 meters.
12.58	————
12.59	————
1.00	————
1.01	Chimes on about 500 meters. Apparently Davenport. Then puts out noise and general merriment in studio.
1.05	As above (1.01) signs. Yes, it's WOC.
1.09	WCX Detroit *Free Press* still on dance music from Book-Cadillac Hotel.
1.11	————
1.14	WOC on studio program. ———— Tenor, "Land of the Sky-Blue Water."
1.19	———— WOC lets a little wire talk go out changing to field pick-up.
1.30	SOS not yet clear. Off watch. All above reception was on superheterodyne and loud speaker.

How Can Broadcast Operators Be Trained?

AS FAR as we know, there is no established school for broadcast radio operators in the United States. Schools for telegraph operators, both wire and radio, exist in sufficient number to meet the demand. But if a young man wants to be-

the making of a radio program

come a technical broadcaster, his only chance at the present time is to get into the employ of some station and to learn the business there. And, as the public becomes more critical and the broadcasters more careful, that chance, at least in the larger cities, is likely to become a slim one.

The source of supply for broadcast operators, up to this time, has been largely from the radio telegraph field, both commercial and amateur. Sea-going operators who had become tired of the briny deep got jobs on shore running broadcasting stations. Some of them, with a good ear for music and an interest in acoustics, added to that part of the technological foundation which is the same for radio telegraphy and telephony, turned out very well. Others with less aptitude for the new field got in and stayed in because the station owners knew even less than they did. Still others made blunders so egregious that they were discharged and became garage mechanics or salesmen. The more talented candidates likewise made blunders, of course, but they did not make the same mistake twice. Also, they had their troubles on the air at a time when the public was less critical.

This fact is not appreciated by some marine radio operators who turn their eyes toward broadcasting. They do not realize that many of the things which they know will have no direct application in a broadcasting station, that there are many problems in such a station with which they have had no contact, and that considerable adaptability and intelligence may be required to close up the gaps. There was a time—it ended about a decade ago—when a radio man was a radio man, and knew, or thought he knew, everything in the art. He was ready to build or handle any type of transmitter or receiver of any power. Nowadays, there are transmitter specialists and re-

ceiver specialists, high power men, low power men, and innumerable narrower divisions. A radio man may be an expert in loud speakers, or in super-heterodyne receivers, or in broadcasting microphones. The body of knowledge and technology which he shares in common with all radio men is no longer all-important; it is only the foundation of a structure of specialized knowledge, and it is the latter which has great economic importance. Broadcasting is one of these divisions. To try to get a job in a broadcasting station on the strength of one's experience in marine radio is somewhat like approaching a Mason for fraternal aid on the strength of the fact that one is a member of the Elks.

A considerable number of technical broadcasters have been recruited from the wire telephone field. These men approached broadcasting from a totally different direction than the radio telegraph people. Broadcasting may be summed up as radio plus acoustics. The difference between a tube set used for telegraphy and the same transmitter used for telephony is one in modulation. Up to the modulation circuits they are the same. In fact, the same transmitter is sometimes used for both purposes by the aid of change-over switches with the proper circuits. The telephone experts knew a good deal more about the acoustical features than most of the radio men. The latter were proficient in getting their waves out on the air and in picking them up, but they were familiar only with relatively simple forms of modulation. The elaborate and exacting modes of impressing the carrier with which they had to deal when broadcasting became the vogue, made some of them feel like brick-layers confronted by a problem in interior decorating.

One possible source of supply for broadcasting technicians, which has scarcely been touched, is the phonograph recording laboratory. The phonograph interests have been faced for many years by acoustic problems similar to those now encountered by the broadcasters, and some of the gramophone recording experts would be an asset to many a broadcasting station. Some really brilliant broadcast performances have in fact been turned out by the operators of a New York station working together with phonograph recording specialists in the latters' laboratories. For a number of reasons, however, there has been little actual interchange of workers between the two fields. The principal reason is that in the case of the phonograph man the first term in the equation, "radio plus acoustics equals broadcasting," is missing, and at the present time, employers in the broadcasting field insist on the first and get what they can in the second. A broadcast technician is expected to know, first, how to run a radio transmitter and the associated amplifiers—the business of tuning, getting maximum radiation, standing a 600-meter watch, oiling generators and grinding down brushes, shooting trouble, and the like; in the second category he must balance up orchestras, detect blasting and all forms of distortion, and act, in short, as a musical critic and adjustor. In time, perhaps, the two functions may become differentiated. One class of operator will tend to the machinery, while the other class of technician will be concerned solely with the music. There is already some tendency in this direction in those stations where the power plant is separated from the studios and control room.

Judging by the inquiries received by a professional broadcaster, many young men are desirous of entering this new field, embracing its romance, and enduring its agonies. For such, a few words of advice may be of interest.

As to general temperament, one requires calmness unmixed with over-confidence. Calmness is essential because broadcasting is a branch of the show business which places even more reliance on machinery than does the theater; it is at best a nervous game, and if the players add to the tension by injecting an excess of temperament at every opportunity, explosions will be too violent and frequent for the successful running of the station. At the same time, on the technical end, a certain controlled apprehensiveness is in order. One must never trust the equipment; at times when one is not on the air one must always be looking for things that may go wrong when the amperes are in the antenna and the multitude is twirling its knobs. "Be not anxious for the morrow, for the morrow will be anxious for itself," is an injunction sadly inapplicable to the broadcaster.

A high school education, or its equivalent in general schooling, is essential. Broadcasting is a business in which one meets many highly cultivated and well-informed people. Good diction, a vocabulary of decent size, and polite deportment, are not qualities to sway the stars from their courses, but they are very useful in such a business as broadcasting: therein, of course, broadcasting is not unique.

General radio experience, as has been said, is necessary at the present time, and will probably always be eminently desirable. Ama-

teur experience is good, professional work is better. A knowledge of physics and of ordinary electrical practice is essential. Acoustics, theoretical and practical, must be studied. Alternating current theory is as important in radio broadcasting as in wireless telegraphy. The influence of inductance and capacitance on currents of various audible frequencies is one of the fundamental problems of broadcasting. Telephone practice is of obvious interest to the broadcaster, since all the larger stations reach out for a considerable part of their program material with wire lines.

While some excellent textbooks have been written on the subject of wireless telephony, a handbook on broadcasting remains a work for the future. However, the subject has been partly covered in its technical aspects by various engineering papers, the study of which forms a good preparation for actual work in the field. This bibliography is as follows:

CASPER. Telephone Transformers (Section on *Frequency Requirements*) *Journal A. I. E. E.*, March, 1924. Page 197.

MARTIN and FLETCHER. High Quality Transmission and Reproduction of Speech and Music. *Journal A. I. E. E.*, March, 1924. Page 230.

JONES. The Nature of Language. *Journal A. I. E. E.*, April, 1924. Page 321.

HITCHCOCK. Applications of Long Distance Telephony on the Pacific Coast. *Journal A. I. E. E.*, Dec., 1923. Page 1264.

OSBORNE. Telephone Transmission Over Long Distances. *Journal A. I. E. E.*, Oct., 1923. Page 1051.

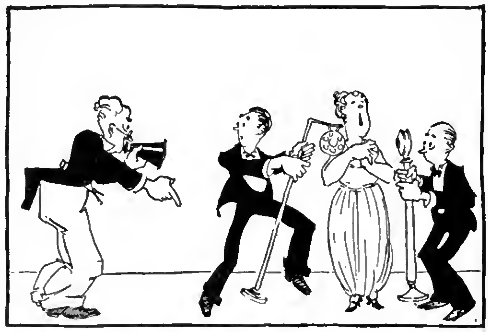
JONES. Discussion on Thomas. A Diaphragmless Microphone. *Journal A. I. E. E.*, Sept., 1923, Page 979.

ARNOLD and ESPENSCHIED. Transatlantic Radio Telephony. *Journal A. I. E. E.*, Aug., 1923. Page 347.

GREEN and MAXFIELD. Public Address System. *Journal A. I. E. E.*, April, 1923. Page 347.

MARTIN and CLARK. Use of Public Address Systems with Telephone Lines. *Journal A. I. E. E.*, April, 1923. Page 359.

WEINBERGER. Broadcast Transmitting Stations of the Radio Corporation of America. *Proc. I. R. E.*, Dec., 1924. Page 748.



the training of a broadcaster

NELSON. Transmitting Equipment for Radio Telephone Broadcasting. *Proc. I. R. E.*, Oct., 1924. Page 553.

LITTLE. KDKA, the Radio Telephone Broadcasting Station of the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa. *Proc. I. R. E.*, June, 1924. Page 255.

BAKER. Commercial Radio Tube Transmitters. *Proc. I. R. E.*, Dec., 1923. Page 601.

BAKER. Description of the General Electric Company's Broadcasting Station at Schenectady, N. Y. *Proc. I. R. E.*, Aug., 1923. Page 339.

NICHOLS and ESPENSCHIED. Radio Extension of the Telephone System to Ships at Sea. *Proc. I. R. E.*, June, 1923. Page 193.

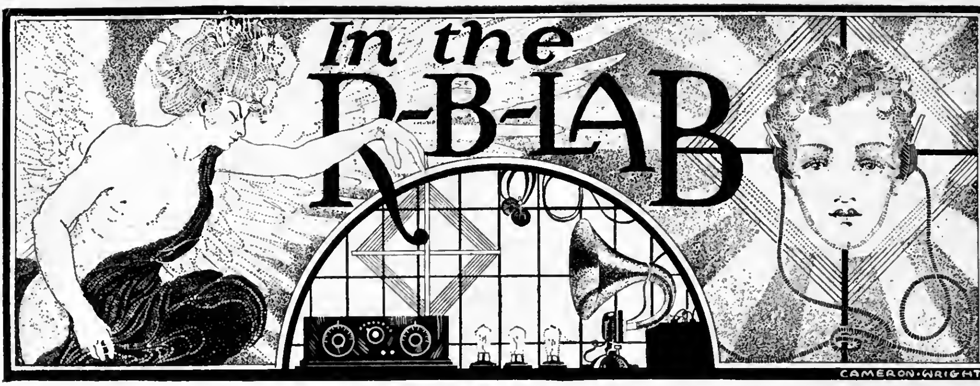
ESPENSCHIED. Applications to Radio of Wire Transmission Engineering. *Proc. I. R. E.*, Oct., 1922. Page 344.

SABINE. *Collected Papers on Acoustics.* Harvard University Press.

MILLER. *The Science of Musical Sounds.* MacMillan.

Some valuable papers are also to be found in the semi-technical periodicals, and the above is by no means a complete summary of the important literature. However, any aspirant who digests all the information in these articles is well on his way to becoming a qualified technical broadcaster. It pains me, in fact, to make public the observation that there are many chief technicians and subordinate operators of metropolitan broadcasting stations who have not read them at all.

EACH month, Mr. Dreher's articles will deal with important and interesting phases of radio broadcasting, discussed particularly from the point of view of the broadcaster. Some of the topics he discusses are highly controversial, and readers who feel, either through their official positions or general knowledge, that they have something definite to contribute on these matters can communicate with the author through RADIO BROADCAST.



SOME NOTES ON THE SECOND-HARMONIC SUPER

THE many fans who are experimenting with the second-harmonic super-heterodyne receiver described by Allan T. Hanscom in RADIO BROADCAST for November, 1924, will be interested in the further developments that more recent experiments have brought out.

> *In the R. B. Lab This Month*
>
> *—Some notes on the second-harmonic super-heterodyne.*
>
> *—A radio power panel for the home constructor.*
>
> *—How to build and use a capacity bridge for important laboratory testing.*
>
> *—The theory of resistance coupling in audio frequency amplifiers and how to use the C battery in such circuits.*

Neutralization or balancing of the first tube is greatly facilitated by the use of a small variable condenser, such as the Chelton Midget, instead of the fixed capacity. This miniature condenser has a capacity of .000045 mfd., and is connected at N in diagram Fig. 1.

The difficulty with the common type of neutralizing condenser is that the capacity is not large enough for use in this circuit. Also, by mounting the small variable condenser on the panel, a certain amount of controlled regeneration may be obtained which builds up the signal strength remarkably on weak stations.

Certain makes of loop antennas require different values of neutralizing capacity, and practically all loops are easily balanced by slight variations of this condenser.

The operator will find that there is one value of neutralizing capacity that will give stability over the entire tuning range of the set, with the single exception of when the oscillator is tuned to a frequency the same as that of the loop. Since the range of the oscillator is from 400 to 1200 meters, and the range of the loop from 200 to 600 meters, this can only occur when the oscillator condenser reads close to zero—a combination that is never effected during actual reception.

Because of the effect of the intermediate frequency secondary shunted across the loop, a variable tuning condenser which has a capacity of .0005 mfd. is scarcely large enough to reach the highest wavelengths. Some manufacturers' condensers fall noticeably short of their maximum rating. If experiment proves that the receiver will not respond to wavelengths such as that employed by WEAF it will be necessary to add turns (one or two) to the loop. Likewise, the oscillator condenser may exhibit similar evidences of too low a capacity.—ALLAN T. HANSCOM.

A RADIO POWER PANEL

FIGURES 2 and 3 show an accessory that will pay for itself many times over wherever it is installed by the radio enthusiast who "builds his own." Detailed consideration will disclose many advantages not apparent at first glance.

The radio fan who builds his own sets usually finds it desirable to test new circuits or parts from time to time, since he tries to keep his receiver as modern and efficient as possible.

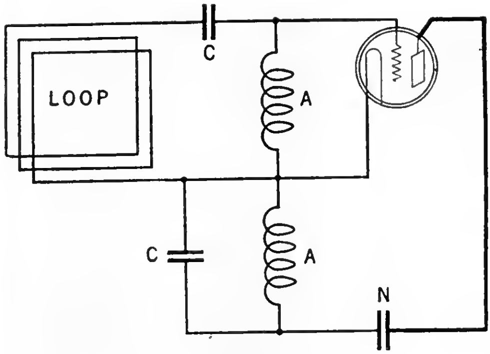


FIG. 1

The loop circuit of the Second Harmonic Super-heterodyne.—"N" is the neutralizing condenser

Only too often, with A, B, and C batteries, and their numerous leads, scattered all over a table, or on the floor under or near the bench, such testing periods not only become a strain on the nerves of the operator, but are a source of actual danger to batteries and tubes. The constant tracing of wires and altering of connections, to determine proper leads and correct voltage, proves quite an inconvenience, while the accidental touching of wires often injures batteries or burns out one or more tubes. The price of one tube, even the cheapest bootleg variety, will more than pay for the materials used in constructing a power control panel.

Although the panel illustrated was installed in the back of the phonograph which contains the receiver and batteries used by the constructor who suggested this arrangement, it would have proved equally useful mounted on the top or side of an ordinary box which would protect the batteries and connections.

Enclosing all batteries and labeling the terminals make repeated tracing of connections unnecessary. The labeled terminals, and short flexible leads with lugs on each end, which connect the panel to the receiver, greatly reduce the possibility of accidental connections due to confusion or a wire slipping from its terminal and falling against another terminal. The triple-pole switch and the spring brass piece at its left, acts as a double-pole single-throw filament cut-off switch and a single-pole double-throw antenna switch which connects the antenna to the set when the filaments are connected, and connects the antenna direct to the ground wire when the switch is opened just enough to break the filament circuit. The switch arm and points left of the triple-pole switch permits instant regulation of C battery voltage from 0 to 6 volts. The center set of switch points effects the regulation of amplifier plate voltage from 1 to 8 batteries. (The extraordinary number of taps permit the adding of extra B batteries

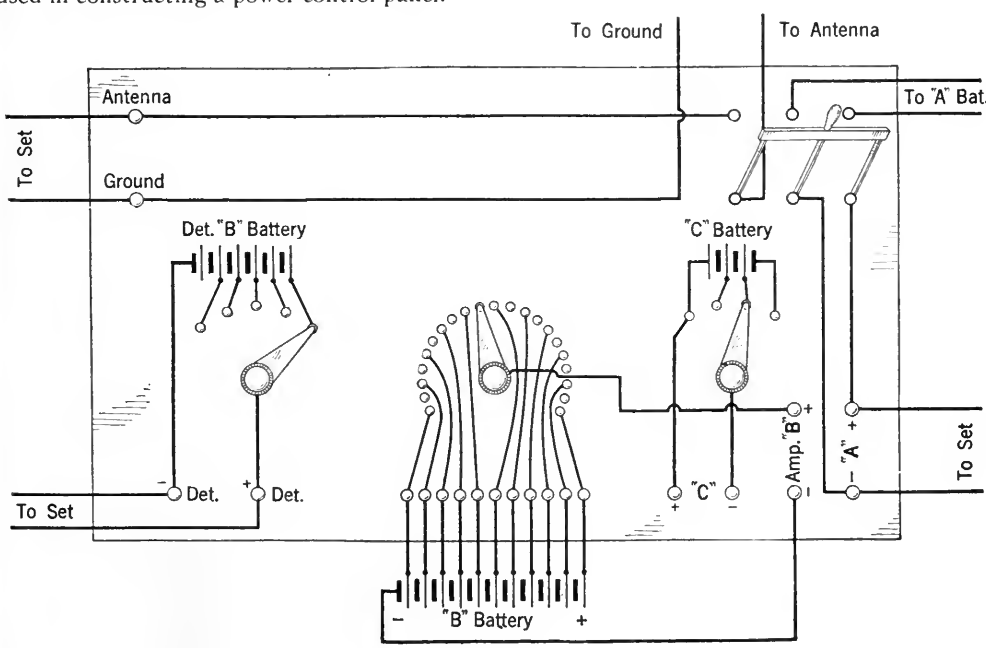


FIG. 2

Schematic connections of the radio power panel. Additional taps for special voltages may be added in any of the circuits

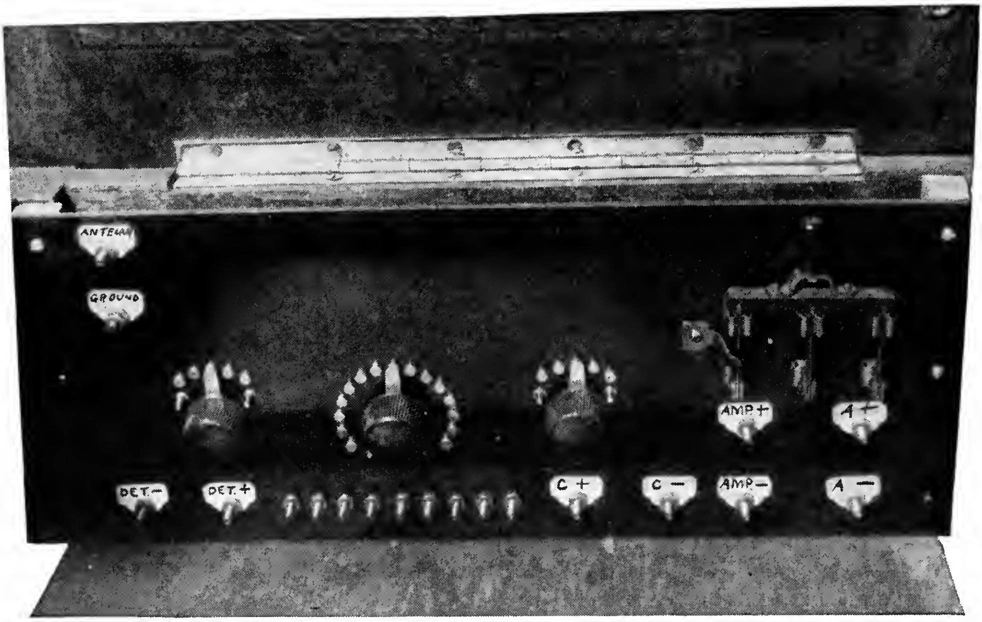


FIG. 3
This power control panel facilitates the testing of receivers and is a most useful addition to any laboratory

as the voltage drops off in use, while the alternating "dead" points prevent a 22-volt "short" every time the switch arm moves from one battery terminal to the next.) The nine screws just below the points permit the convenient testing of individual batteries for voltage or noise, and for "shorting out" any defective B battery which may be removed from the circuit at a later and more convenient time. The set of points at the left permit instant regulation of detector plate voltage from 16 to 22 volts.

It will be noted that none of the circuits are connected behind the panel, which permits any desired interconnection of circuits within the receiver itself.

The builder of the panel shown, who does considerable experimenting, and sometimes tests out equipment for others, has found that next to his A storage battery and battery charger, the power-control panel is the most useful piece of radio equipment he owns.

—Glenn McWilliams

A HANDY CAPACITY BRIDGE

SEVERAL suggestions have been received by this department, evidencing an interest in an easily constructed capacity bridge for general test or checking work. Figs. 4 and 5 illustrate an instrument of this character that was built up in the laboratory one afternoon, and which has proved itself of considerable value in routine work, such as checking and determining the capacities of small fixed condensers, and testing them for break-down or faulty insulation.

The circuit as shown in Fig. 4 and Fig. 5 is a photographic illustration of the ensemble mounted baseboard fashion. The parts used in this instrument are one telephone jack, four Fahnestock clips, one 50,000 ohm resistor (Daven) and mounting, one Bradleyohm (No. 10), two condenser clip mountings (Daven) and one variable condenser .001 mfd. maximum capacity. This last may be of the usual air type (the best form) or a Dubilier Variodon. It should have a straight line capacity characteristic, i. e., the capacity changes should be proportional to the dial settings. If 180 degrees gives .001 mfd., 90 degrees should be close to .0005 mfd.

The connections in Fig. 4 are almost self explanatory. R_1 is the Bradleyohm; R_2 is the fixed 50,000 ohm resistance; C_1 is the variable condenser and C_x is the unknown capacity which is clipped into the convenient mounting. The extra mounting is shunted across the variable condenser, so that its effective capacity can be increased by

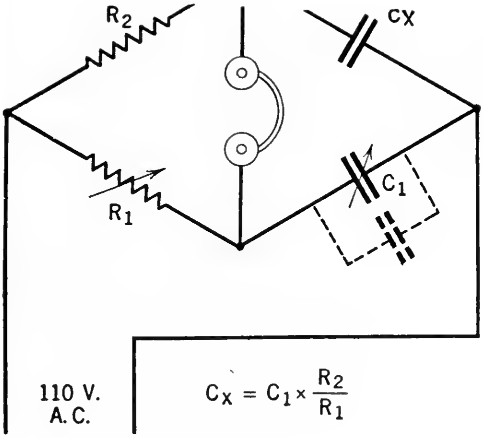


FIG. 4
The connections of the simple capacity bridge. The telephone receivers are most conveniently plugged into a jack

clipping in fixed condensers of reliably known values.

The phones and 110-volt A. C. lines are connected as indicated. The operation of the bridge is possible in two ways. The more simple and easily understandable is as follows:

R_1 should be set at the same resistance as R_2. This can be determined with a milliammeter, voltmeter and a B battery. Resistance in ohms is always equal to volts divided by current. This desired setting can also be arrived at by placing a condenser of .001 mfd. capacity in the "X" clip and turning C_1 to maximum, that is the same .001 mfd. capacity. R_1 is now adjusted until no alternating current hum is heard in the telephone receivers. At this adjustment the bridge will be "balanced," and R_1 will equal R_2. To check an unknown capacity this procedure is reversed. The doubtful condenser is clipped into the "X" mounting and the capacity of C_1 is varied until no sound is heard in the receivers. At this point, the unknown capacity will be equal to C_1.

The second method, while a little more complex, is preferable where convenient, and makes possible measurements of C_x, within reasonable limits, without adding capacities in shunt of C_1. In this case C_2 is generally turned to its highest setting, and R_1 adjusted for no response in the phones. The resistance of R_1 should be measured at this setting. The capacity of C_x can then be determined from the equation

$$Cx = \frac{R_2}{R_1} \times C_1$$

If, for example, R_2 has a resistance of 50,000 ohms, C_1 is set at .001 mfd., and the resistance of R_1 is found to be 25,000 ohms at the full adjustment, substituting in the above equation will determine the capacity of C_x as .002 mfd.

A leaky condenser will indicate only a reduction in hum, noticeably different from the almost absolute silence of a perfect condenser. A shorted capacity will give an increased hum that is constant regardless of adjustments.

THE C BATTERY AND RESISTANCE COUPLING

DUE to the meager justification for resistance-coupled audio amplification prior to the advent of radio telephonic broadcasting, its treatment in radio publications and the popular text books has been scant

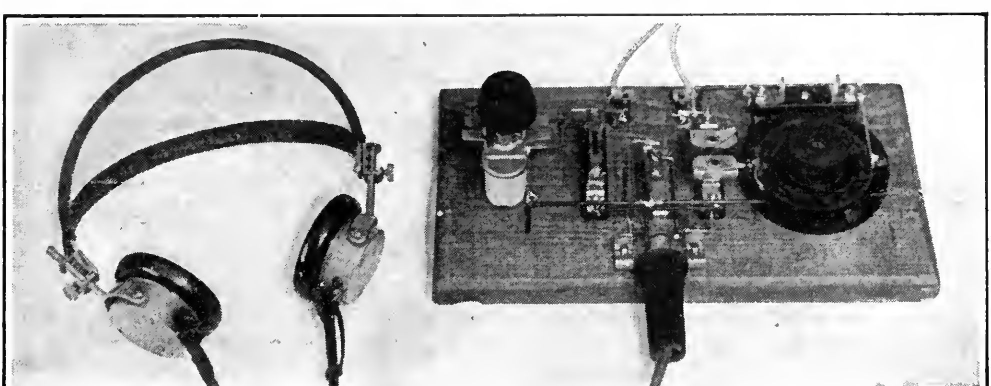


FIG. 5
This capacity bridge is quickly built and the more serious enthusiast will find it most useful

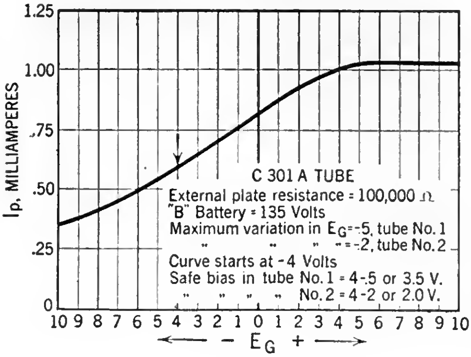


FIG. 6

The dynamic curve of a C-301-A tube taken under the conditions mentioned on the chart

and inadequate. Since resistance-coupled intensification was popularized by RADIO BROADCAST magazine as an amplifier ideally suited to the requirements of the broadcast enthusiast, many additional articles, in a variety of publications, have endeavored to throw light on the subject. However, due to the general lack of understanding, these write-ups have been of little avail. With few exceptions they have ignored the unique characteristics of resistance coupling, and have borrowed too freely from transformer-coupled phenomena in the attempt to make clear the functioning of the resistance-coupled system.

The most prevalent error has been the recommendation of a bias of similar proportions to that employed in transformer-coupled intensification. This ignores a fundamental difference between the actions of these two amplifiers. A transformer-coupled amplifier (in a vast majority of cases) modulates up while a resistance-coupled amplifier modulates down. That is, signal variation in a transformer-coupled amplifier places a plus potential of varying strength on the grid of the succeeding tubes causing the plate currents to increase, while a similar variation in a resistance-coupled intensifier, places minus potentials on the amplifying grids, causing the currents to decrease. The effect in a transformer-coupled amplifier is the placing of a positive bias on the grids, varying with the speech or music; while that in a resistance-coupled set is just the opposite. It was in appreciation of this, the significance of which will be explained shortly, that RADIO BROADCAST has not, in its past articles on resistance coupling, advised the use of a negative bias.

Figs. 6 and 7 are the "dynamic" curves of two vacuum tubes, a Cunningham C-301-A and a Western Electric 216-A respectively. "Dynamic" refers to curves taken under conditions closely similar to those under which the tubes are to be operated. In the case of the C-301-A this means measurements were taken with a 100,000-ohm coupling resistance in the plate circuit. The winding of the loud speaker was included in the plate circuit of the power tube. These conditions are practically those indicated in the circuit, Fig. 8, in which the first two tubes are C-301-A's (or similar tubes) and the last tube, outputting to the speaker, is the WE-216-A.

The figures along the base of the curve, or abscissa, indicate the grid potential in plus or minus volts, and the vertical figures the plate current corresponding to different grid voltages. It will be observed that as the grid potential becomes positive, the current rises, and vice versa. Toward the upper and lower extremes of the characteristic curve, the line, which is quite straight immediately on both sides of the zero grid potential, bends. In other words, continued variations of the grid potential, in the same direction, no longer cause so great changes in the plate current. (The upper bend, being off the chart, is not shown in the 216-A curve.) Thus, if signals are so intense that they carry the grid potential down to the curve or bend, the plate current changes cease to vary in proportion to the signal fluctuations. The plate current changes, however, are responsible for the audio output, or the amplified impulse passed on to the next stage. Thus, if the curve portion of the characteristic is touched, the audio output will no longer vary exactly with the

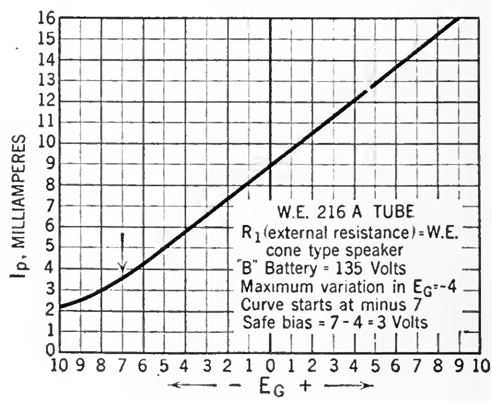


FIG. 7

A similar curve of a Western Electric 216-A power tube. These curves greatly facilitate the analysis of the action of an amplifying bulb

original signal. A single familiar word describing this condition is "distortion."

We may, therefore, write down, as the first law to be observed in distortionless amplification: The signal variation must be confined to the straight portion of the characteristic curve. It will be observed that the straight line begins to curve at minus 4 and minus 7 volts respectively in the Cunningham and Western Electric tubes.

There is another precept of distortionless intensification and that is that the grid must never become positive. All variations must be between zero and where the lines begin to curve, on the minus side. This rule which must be obeyed to the letter in transformer coupling, is less strict in the case of resistance-coupled amplifiers.

Therefore, in a transformer-coupled amplifier, which tends to move up the curve, a bias may be used to keep the top of the maximum impulse below the zero line. For instance, a negative bias, in the case of Fig. 7, of seven volts may be applied to the grid, and the upward impulses will all vary along the straight line. However, in the case of resistance-coupled amplification, with a similar bias, the slightest movement *down* would necessarily fall on the straight portion of the curve, with resulting distortion. (In some cases of extreme bias with a resistance-coupled amplifier, modulation will turn, somewhere on the curve, and begin to climb. This is equally bad, for it indicates a double space current change for a single grid impulse — i.e., the generation of harmonics.)

HOW MUCH BIAS IS PERMISSABLE?

THE amount of C battery bias in a resistance-coupled amplifier is simply determined, merely by subtracting the amount of maximum minus grid signal variation from the permissable bias, or the point where the curve commences. If the curve is straight to minus seven volts, and the maximum grid variation is minus four volts, it is evidently possible to place an additional bias of three volts without causing distortion, by means of a C battery. This is exactly the case with the 216-A tube according to measurements made in this laboratory with a plate battery of 135 volts.

It will be observed that in the case of the first two tubes, which are the same as far as the curve is concerned, the line breaks at about minus four volts. This, of course, precludes the possibility of a large bias. Indeed, consideration of the very many curves made in this laboratory, which indicate a much earlier break (at minus one or two volts) with what bulbs were available, a C battery bias is not recommended in these stages. As the plate current consumption in these tubes is very low, about one milliampere with 100,000-ohm plate resistors and a 135-volt B battery, the bias is not necessary from the standpoint of economy. It is therefore suggested that the bias, on the first two tubes of a three-stage amplifier, be secured from the drop across the filament and rheostat. This will be well within the safe limit, with a margin for poor tubes.

The recommended circuit for a three-step resistance-coupled amplifier is shown in Fig. 8. The first two tubes receive their bias in the manner suggested, while a three volt C battery is included in the grid circuit of the last or "open" tube. The usual values of C and R are given on the diagram. Tests and curves made in THE R. B. LAB indicate that this diagram holds good for practically all storage battery tubes. With dry cell tubes, the C battery should be reduced to one and one half volts.

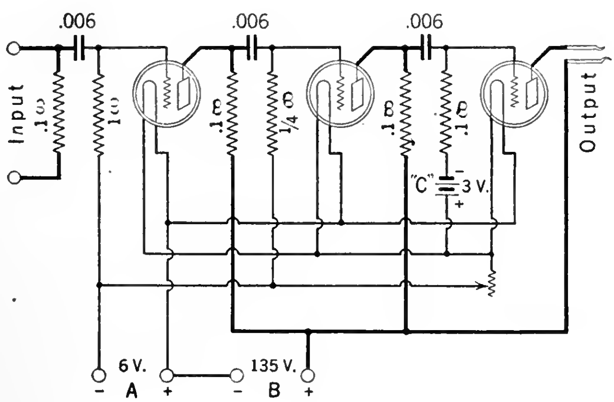


FIG. 8

The ideal connections for a resistance-coupled amplifier. This diagram is arrived at after a careful consideration of the resistance coupled amplification characteristics of standard tubes

New Broadcasting Wavelengths

FOR some time, the radio service of the Department of Commerce has been engaged in reallocating the wavelengths of many of the broadcasting stations in the Class B group. Stations of this class are those with power of at least 500 watts and especially efficient equipment. It is understood that the purpose of this readjustment is to make room for the many new applications for Class B licenses. Finer shades of differentiation between the stations now licensed has been tried. It is probable that if these allotments do not prove satisfactory, still other alterations may be made, though it is likely that the further changes, if made, will not be very great.

Among the changes made are KDKA from 326 to 309, WGY from 380 to 379.5, WIP from 509 to 508.2, WOO from 509 to 508.2, WDAR from 395 to 394.5 meters.

To station WMH at Cincinnati was allocated two wavelengths, 325.9 during the month when it divides time with station WSAI and 422.3 during the month, when it shares broadcasting time with station WLW, also of Cincinnati.

Wavelengths in meters, call letters, and locations announced by the Department are as follows:

Wave Length	Call Letters	Location
280.2	WNAC	Boston
282.8	WOAN	Lawrenceburg, Tenn.
285.5	WREO	Lansing, Mich.
285.5	WEMC	Berrien Springs
285.5	WKAR	East Lansing, Mich.
288.3	KFKX	Hastings, Neb.
293.9	WEAO	Columbus, Ohio
293.9	WBAV	Columbus, Ohio
296.9	KFRU	Bristow, Okla.
299.8	WPG	Atlantic City, N. J.
302.8	WTAS	Elgin, Ill.
302.8	WJJD	Mooseheart, Ill.
305.9	WJAR	Providence, R. I.
309.1	KDKA	East Pittsburgh, Pa.
315.6	WAHG	New York
315.6	WGBS	New York
315.6	KFDM	Beaumont, Tex.
319.0	WGR	Buffalo, N. Y.
322.4	KOA	Denver, Col.
325.9	WMH	Cincinnati, Ohio
325.9	WSAI	Cincinnati, Ohio
333.1	WBZ	Springfield, Mass.
336.9	WSAC	Clemson College, S. C.
336.9	KFMX	Northfield, Minn.
336.9	WCAL	Northfield, Minn.
340.7	WKAQ	San Juan, Porto Rico
340.7	KSAC	Manhattan, Kan.
344.6	WLS	Chicago, Ill.
344.6	WCBD	Zion, Ill.
348.6	KOB	State College, N. M.
348.6	WTIC	Hartford, Conn.
352.7	WWJ	Detroit, Mich.
352.7	WJAD	Waco, Tex.
361.2	WHN	New York
365.6	WHB	Kansas City, Mo.
365.6	WDAF	Kansas City, Mo.
370.2	WEBH	Chicago, Ill.
370.2	WGN	Chicago, Ill.
374.8	KTHS	Hot Springs, Ark.
379.5	WGY	Schenectady, N. Y.
379.5	WHAZ	Troy, N. Y.
384.4	WMBF	Miami Beach, Fla.
389.4	WTAM	Cleveland, Ohio
389.4	WEAR	Cleveland, Ohio
394.5	WFI	Philadelphia, Pa.
394.5	WDAR	Philadelphia, Pa.
394.5	WOAI	San Antonio, Texas
399.8	WHAS	Louisville, Ky.
405.2	WOR	Newark, N. J.
405.2	WJY	New York
416.4	WCCO	Minneapolis, Minn.
422.3	WLW	Cincinnati, Ohio
422.3	WMH	Cincinnati, Ohio
428.3	WSB	Atlanta, Ga.
434.5	NAA	Arlington, Va.
440.9	WDWF	Cranston, R. I.
440.9	WOS	Jefferson City, Mo.
447.5	WQJ	Chicago, Ill.
447.5	WMAQ	Chicago, Ill.
454.3	WJZ	New York
461.3	WCAE	Pittsburgh, Pa.
468.5	WCAP	Washington, D. C.
468.5	WRC	Washington, D. C.
475.9	WEEI	Boston, Mass.
475.9	WBAP	Forth Worth, Tex.
475.9	WFAA	Dallas, Tex.
483.6	WHAA	Iowa City, Iowa
483.6	WOC	Davenport, Iowa
491.5	WEAF	New York
499.7	WMC	Memphis, Tenn.
508.2	WOO	Philadelphia
508.2	WIP	Philadelphia
516.9	WCX	Detroit
526.0	WNYC	New York
526.0	WHO	Des Moines, Iowa
526.0	WOAW	Omaha, Neb.
535.4	KYW	Chicago, Ill.
535.4	WHA	Madison, Wis.
545.1	KSD	St. Louis, Mo.
545.1	KFUO	St. Louis, Mo.

Radio-Frequency Amplification and How to Measure It

A Clear Theoretical Discussion—Circuits to Measure Amplification—Proper Design of Coupling Devices

BY HARRY DIAMOND

Department of Electrical Engineering, Lehigh University

IN THIS paper, the interested technical reader will find radio-frequency amplification most thoroughly discussed from the theoretical side with some very helpful diagrams and curves. Mr. Diamond attempts theoretically to show that for radio-frequency coupling, a choke coil having a natural wavelength equal to the signal to be received is better than a coil tuned by a condenser to the desired wavelength, and other important facts about coupling-coil design.

Much credit for the experimental work and circuits used in this article is due to H. T. Friis and G. A. Jensen, engineers of the Western Electric Company from whose paper "High Frequency Amplifiers" (which appeared in the *Bell System Technical Journal* for April, 1924) much of this material is taken.—THE EDITOR.

A RADIO amplifier is a device which makes possible the reception of very weak incoming signals by increasing or amplifying their strength. It must therefore be a kind of trigger which, whenever actuated by the extremely small signal voltages of the antenna, releases from a local energy source an amount of energy much greater than that actuating the antenna.

The vacuum tube is admirably fitted for such action. The grid constitutes the trigger device and the plate supply battery the local energy source. The small signal voltage variations impressed upon the grid or input circuit of the tube are reproduced on a much larger scale in the plate or output circuit, the amount by which the signals are amplified being known as the amplification factor of the tube. The actual voltage variations passed on to the next tube, however, depend not only upon this factor, but also upon the value of the impedance in the plate circuit which serves to couple the amplifier tube with the next tube.

Amplifiers are therefore classified according to the nature of this coupling impedance being known as resistance-coupled, inductance-coupled (tuned or untuned), or transformer-coupled amplifiers. (See Figs. 1, 2, and 3.)

It should be noted that amplification may take place either before or after detection. In the first case this requires the use of a radio-frequency amplifier, and the second an audio-frequency amplifier. The advantage of using the former depends chiefly upon the nature of static interference. It is well known that this type of interference sets up voltage variations in the antenna well within the audible frequency range. If we use a radio-frequency amplifier, then, the radio-frequency signal voltages are amplified while the voltages due to static interference remain unamplified (theoretically). On the other hand, an audio-frequency amplifier amplifies not only the rectified signal voltages but also those due to the atmospheric disturbances.

Unfortunately, however, the design of an economical radio-frequency amplifier which will work efficiently on the shorter wavelengths used in broadcasting, is a very difficult matter. The advantages gained in reducing the effect of "static interference" are often lost due to the distortion introduced by the amplifier.

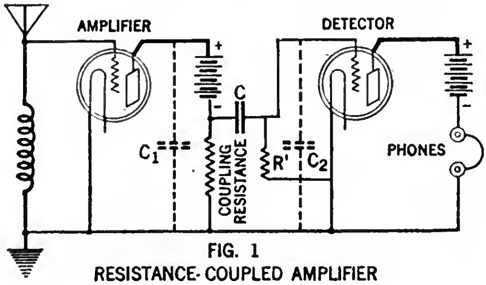


FIG. 1
RESISTANCE-COUPLED AMPLIFIER

Again, at radio frequencies, the plate to filament capacity of the amplifying tube (c_1 in Figs. 1, 2, 3) constitutes a low impedance placed in parallel with the primary of the coupling impedance, while the grid to filament capacity of the next tube (c_2, Figs. 1, 2, 3) constitues a low impedance placed in parallel with the secondary of the coupling impedance. The net effect is to reduce the magnitude of the voltage variations passed on from one tube to the other, thus reducing the amount of amplification.

Other serious problems of design arise, depending on the type of amplifier. We shall here mention some of the problems common to each type and then describe a hook-up devised by engineers of the Western Electric Company, whereby the exact characteristics of each amplifier may be obtained, under actual operating conditions. With the aid of this method of test, it becomes possible to design an amplifier which will give a maximum of amplification with a minimum of distortion.

The term "distortion" as used here is intended to indicate that the amplification is not constant but varies with the frequency whether it be radio or audio.

RESISTANCE-COUPLED AMPLIFIERS

RESISTANCE varies but little with the frequency, being very nearly the same for direct currents, for alternating currents of audio-frequencies and for those of radio-frequencies. The value of the coupling resistance being then independent of the frequency of the signal note, all signals are equally amplified and little or no distortion is introduced.

However, the very fact that the coupling resistance offers the same opposition to the flow of direct current that it does to alternating currents constitutes one of the disadvantages of this type of amplifier. Much higher B battery voltages are made necessary, since the net plate voltage available equals the battery voltage *minus* the voltage drop caused by the direct current flowing through the coupling resistance.

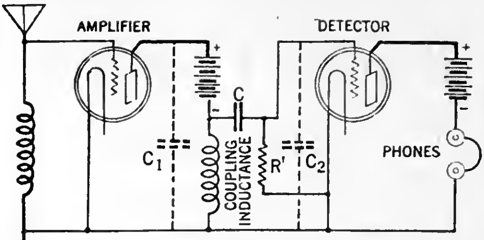


FIG. 2
INDUCTANCE-COUPLED AMPLIFIER

Furthermore, the maximum amplification theoretically possible with this amplifier is equal to but one half the amplification factor of the tube used. More tubes are therefore necessary for the same increase in signal strength. The cost of upkeep is also greater because the B batteries must be of higher voltages, as explained, must supply energy for more tubes, and must also compensate for considerable energy loss in the coupling resistances.

INDUCTANCE-AND TRANSFORMER-COUPLED AMPLIFIERS

THE main advantage of both the inductively coupled and the transformer-coupled amplifiers is that the inductive impedance placed in the plate circuit of the amplifying tube offers a very low resistance to direct currents and a very high impedance to high frequency currents. The plate supply battery furnishing the direct current in the plate circuit may then be of but slightly higher voltage than the rated voltage of the tube, since the voltage drop in the resistance is very small. Another advantage is that nearly the full amplification property of the tube may be utilized, which reduces the total number of tubes necessary. Either the inductance-coupled or the transformes-coupled amplifier can therefore be used in a relatively inexpensive circuit.

An important disadvantage common to both amplifiers, however, is that signal notes of frequencies near the resonant frequency of the coupling impedance are very well amplified, while those of much lower or much higher frequencies are very poorly amplified. Consequently, considerable distortion is introduced. This disadvantage often offsets any advantage in cost or increase of amplification. An obvious solution lies in using a coupling inductance or transformer whose resonant frequency is at least twice the frequency of the incoming

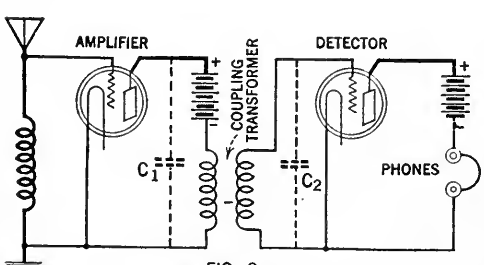


FIG. 3
TRANSFORMER-COUPLED AMPLIFIER

signals. The design of such a circuit requires the greatest care. In order to make a thorough study of the best possible hook up, a dependable method of measurement under actual operating conditions is necessary.

Such a method of measurement has been developed in the Bell System Laboratories and has proven very successful. Fig. 4 shows the circuit diagram of the apparatus used. The input apparatus is shown at the left. An oscillator (or generator of high-frequency currents having a range of from 400–1500 kilocycles [200–750 meters] is connected in series with a potentiometer and a sensitive thermo-couple ammeter (or a hot-wire milliammeter with a 1-m.a. scale) used for measuring the value of the very small current flowing in the circuit. This current, I, flowing through the resistance R_4 of the potentiometer causes a potential difference between the terminals of this resistance equal to IR_4. This potential difference is then impressed between the grid and filament of the amplifying tube, A_1. Obviously by varying the value of either the current I or the resistance R_4, the potential difference impressed upon the input circuit of the tube may be varied.

The output potential difference of the amplifier stage is measured by means of the tube voltmeter B. This is merely a vacuum tube whose variations of plate currents for different values of alternating grid voltages are known. A given *change* in the plate current, as recorded by the plate ammeter, signifies then that an alternating voltage of definite value has been impressed upon the grid circuit.

THE C BATTERY

THE purpose of the C battery shown is to make the grid negative and thus limit the value of the direct-current flowing in the plate circuit. With this current reduced, it is possible to adjust the balancing device shown so that the plate ammeter will read zero when

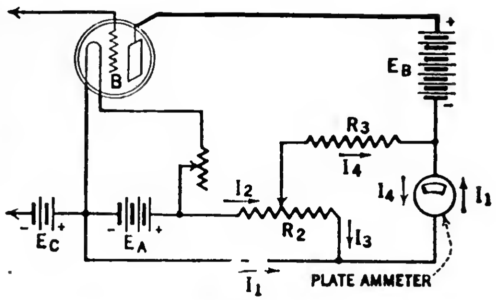


FIG. 5
DETAILS OF BALANCING ARRANGEMENT

there is no input to the grid. With this arrangement, the entire scale of the plate ammeter is in use, thus increasing the accuracy of the readings taken. Also, the measured voltage may be obtained from a single reading instead of from the difference of two readings.

The action of the balancing device may be understood from the portion of Fig. 4 to the right of the tuned amplifier, reproduced in Fig. 5. Consider the case when there is no input to the grid circuit of the voltmeter tube B. Under normal conditions, there is then a direct current in the plate circuit of a magnitude depending on the value of the B and C batteries. The direction of this current is shown by the arrow I_1. With the balancing arrangement as shown, the filament battery sets up a secondary current, I_2, which divides into I_3 and I_4. It is seen that I_4 is in a direction opposite to I_1. If the value of R_2 and R_3 is properly adjusted, I_4 may be made equal to I_1. The plate ammeter will then read zero.

Now, when an alternating voltage is impressed between the grid and filament of the voltmeter tube, an alternating current will be superimposed upon the direct current I_1. The value of I_4 will, however, remain constant. The plate ammeter therefore records directly the value of the alternating plate current. The voltage impressed upon the grid can then be found from established curves.

It is necessary first to calibrate the tube voltmeter. This is done by disconnecting it from the amplifier and connecting it directly across the potentiometer R_4—R_5. R_4 is then adjusted to some definite value, say 500 ohms and the current through it adjusted to say

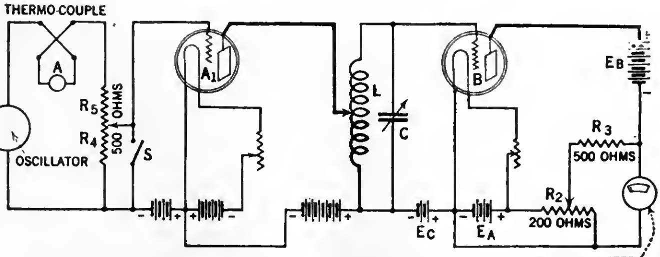


FIG. 4
METHOD OF MEASUREMENT OF TUNED AMPLIFIER

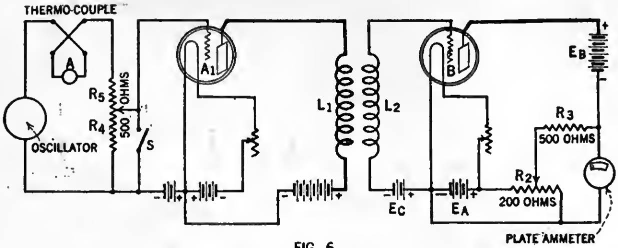


FIG. 6
METHOD OF MEASUREMENT OF TRANSFORMER-COUPLED AMPLIFIER

one milliampere. A resultant voltage of 0.5 volt is thus impressed upon the grid circuit of the tube and the corresponding change in plate current recorded.

The tube voltmeter is then replaced in its normal place in the circuit and the resistance R_4 reconnected to the input of the amplifier. Keeping the value of the current through R_4 constant at one milliampere, the resistance R_4 is reduced until the change in the tube voltmeter plate current is the same as before. The voltage impressed upon the grid of the amplifier is then the new value of R_4 times 0.001 ampere (1 milliampere). The voltage put into the grid of the voltmeter tube, which is also the output voltage of the amplifier is still 0.5 volt since the change in the voltmeter tube plate current is the same. The amplification factor of the stage is then equal to $\frac{.5}{.001 R_4}$. If R_4 was reduced to, say 50 ohms, the amplification factor is equal to 10.

In the circuit as described, considerable precaution has been taken to make certain that no energy passes into the amplifier circuit except that which may be measured by the voltage drop across the resistance R_4. The undesirable "pick-up" energy may be due to coupling to some stray source of energy. An excellent test for the presence of this "pick-up" is the closing of the switch "S" placed at the input of the amplifier. With this switch closed there should be no input to the tube voltmeter. The ammeter in the plate circuit of the tube voltmeter should read zero.

With the measuring apparatus here described, the resistance R_4 can be reduced to 1 ohm, the results obtained still being dependable. This means that an input voltage to the amplifier as low as 0.001 volt or 1 millivolt can be obtained. If the maximum input voltage to the tube voltmeter is limited to 0.5 volt, the maximum amplification that can be measured is then 500. For amplification factors above 500, the same apparatus can still be used by means of an indirect method.

It should be noted that the resistance R_4 must be absolutely independent of the frequency. Otherwise, the tube would be incorrect for all frequencies except for the one at which it was calibrated.

USES FOR THIS MEASURING APPARATUS

THE uses to which the measuring apparatus here described can be put are numerous. For example, Fig. 4 shows a tuned amplifier being tested. Keeping the magnitude and frequency of the oscillator current constant, the circuit may be tuned to resonance by means of the variable condenser C. The lead from the plate of the amplifier tube A_1 to the coil is then moved along the coil until a point is reached which gives the maximum reading of the ammeter in the plate circuit of the tube voltmeter. (The amplifier must, of course, be retuned for each point tried.) This is the point of maximum amplification.

The best step-up for a certain frequency being now established, we may measure the amplification for different frequencies and thus obtain the frequency range possible with this amplifier. Results may show that the frequency range is so narrow that considerable distortion would be introduced by the use of this amplifier. Since the frequency range for a given amplifier decreases as its amplificaton increases, it may therefore be advisable to increase our frequency range at the expense of the amplification by varying the step-up.

TESTING A TRANSFORMER-COUPLED AMPLIFIER

FIGURE 6 shows the hook-up for testing a transformer-coupled amplifier. The connections are the same as for testing the tuned amplifier with the exception, of course, of the details for the amplifiers.

Referring to Fig. 7, curve A shows the variation of amplification with frequency for a tuned amplifier for the step-up which gives the maximum amplification. The coil used consists of a single layer solenoid closely wound with 61 turns of No. 28 solid wire, and having an inductance of 200 micro-henries. The tuning condenser was set for 95.0 micro-micro-farads.

B is a similar curve for a choke coil amplifier, (tuning condenser omitted) for the condition of maximum amplification. This coil consists of 173 turns of No. 28 solid wire, wound in

the same manner as the first coil, and having an inductance of 1630 micro-henries. It will at once be noted that while there is little choice between the tuned amplifier and the choke coil amplifier with respect to frequency width, there is a considerable difference in the amplification obtained, the choke coil giving nearly twice the amplification of the tuned circuit. However, it is to be remembered the choke coil amplifies at the resonant or peak frequency.

In general, the highest amplification is obtained when the inductance is as large as possible for the frequency in question, that is, for the smallest possible value of the tuning condenser. With choke coils, the value of the tuning condenser is, of course, zero. The distributed capacity of the coil must, however, be considered. To get a high amplification,

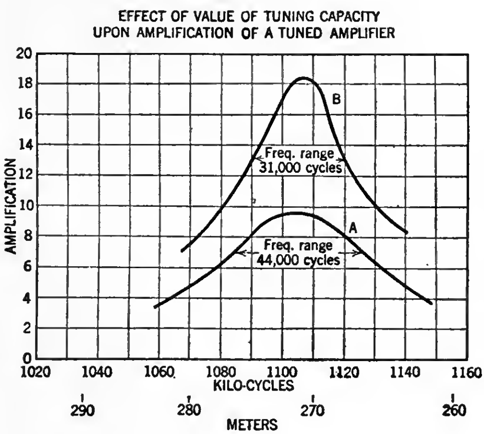


FIG. 7

small coils made of fine, solid wire and with large inductance and small distributive capacity should be used, rather than large coils made of stranded wire and with smaller inductance but larger distributive capacity. In practice, it is not important to go to extremes to reduce the distributed capacity by one or two micro-micro-farads, since the coil is always shunted by the tube capacities, which are of the order of 10 micro-micro-farads, and the distributive capacity of the coil here used was only 3.5 micro-micro-farads.

CHOOSING A PROPER TURN RATIO

FIGURE 8 shows the effect of the ratio of turns on the amplification and the frequency range obtained with a choke coil amplifier. Curve A is for a step-up ratio of 1:5, 34 turns being connected between the plate and filament of the amplifying tube and

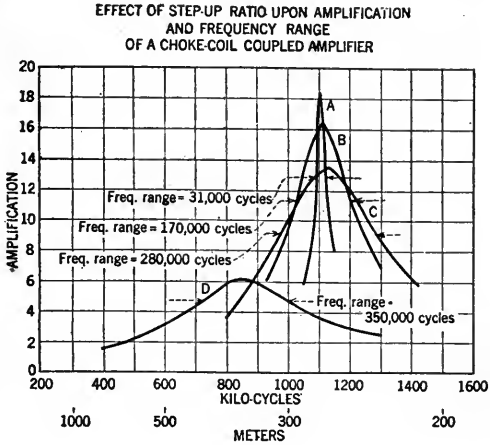


FIG. 8

the entire 173 turns across the grid and filament of the voltmeter tube. Similarly, curves B, C, and D are for step up ratios of 1:3, 1:2, and 1:1, respectively. As noted above, the choice of the proper ratio of turns is largely a compromise between the magnitude of the amplification and the width of the frequency band. For the particular choke coil here considered, a step-up ratio of 1:2 (curve C seems to be the best from both points of view). While giving an amplification considerably greater than for the 1:1 ratio, the frequency range obtainable is not very much less. A step-up ratio somewhere between 1:1 and 1:2 might give even better results.

Fig. 9 shows the amplification curve for a loosely coupled transformer, having two similar pancake coils, 2 inches in diameter, wound with 210 turns of No. 28 solid wire. The distance between the coils is equal to $\frac{3}{8}$ inch. By actual measurement at low frequencies, the inductance of each coil was found to be 2100 micro-henries and the mutual inductance 950 m. h.

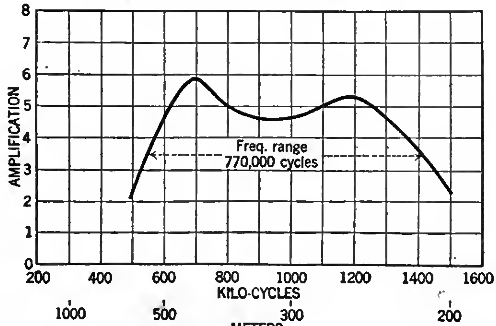


FIG. 9

Do You Know of a Better Receiver for Home Construction?

We Believe RADIO BROADCAST'S Four-Tube Knockout Is the Best and Will Pay $100 for Description of a Better One

BY ARTHUR H. LYNCH

RADIO BROADCAST, from its first number, has been endeavoring to provide its readers with the most reliable radio information it is possible to obtain. In no section of the magazine is this more evident than in the description of various receivers for home construction. We have refrained from publishing descriptions of receivers just because they were new; they had to be *better* than information previously published.

And now, after considerable experience with the two- and four-tube Roberts Knockout receivers, we believe them to be better for home construction than any other receivers employing the same number of tubes ever described in any periodical. We want our readers to have the best it is possible for a very rapidly expanding art to produce and to this end we are at work, in three different laboratories, attempting to produce something better than the design which Walter Van B. Roberts gave us.

You will find, from reading Keith Henney's article on page 1078 of this magazine, that we have done a great deal of experimenting in our efforts to improve and simplify the fundamental circuit. Frankly, we have not improved the circuit, but we have found that the receivers employing the circuit may be improved by paying particular attention to the parts used in its building. Frankly, too, this improvement, though very much worth while, is not at all revolutionary.

Coils, transformers, condensers, sockets, resistances of all kinds, and parts of almost every kind have had their day in court and though there is a difference in the performance, when all the parts employed are good, the difference is very slight and in most cases it is negligible.

WHERE CAN A BETTER RECEIVER BE FOUND?

WE HAVE hunted high and low for something better. We have carefully experimented with many other receivers—in fact, nearly every night for the past six months several members of our staff have hunted very diligently right up to the wee hours of dawn. We have come to know circuits by their middle names and all this work has been in vain so far as finding a new circuit worthy of the name is concerned.

As we said at the outset, we are making every effort to provide readers of RADIO BROADCAST with the most reliable information on valuable changes in receiver design. For this reason we are calling upon our readers to assist us in a task which, up to now, has brought us but little information not already well known. In a nutshell our proposition is this: We want you to assist us in locating a receiver design better than the two- and four-tube Knockouts.

Do you know of a better receiver? If so, you will not even have to write an article describing it or supply us with diagrams or other illustrations to win the prize which we are offering. If you are convinced that you have a better type of receiver, send us a set all made up according to your design. If it meets with the approval of our laboratory staff, we will mail a check for $100 to you, provided, of course, that you will permit us to describe the receiver in RADIO BROADCAST and other publications under our control.

On the other hand, if, after the receiver has met with our approval, we can have an article describing it by you, we will pay generously for it, particularly if accompanied by suitable diagrams and illustrations.

Below we outline the problems more specifically and suggest that before submitting a receiver for test you test it against a four-tube Knockout receiver yourself. This will save time for you and for us.

SPECIFICATIONS OF THE DESIRED RECEIVER

THE receiver we are looking for must meet the qualifications outlined below:

1. The receiver must not radiate.
2. It may employ four tubes (or less if you think four are unnecessary).

3. It must be extremely selective.
4. It must be made of parts which may be had from dealers in at least ten large cities.
5. It must be capable of operation with both dry cell and storage battery tubes.
6. It must be capable of proper operation with tubes operated at their normal filament voltage.
7. It must be built to permit the transfer of tubes from one socket to another without materially changing the results obtained.
8. It must produce good quality, without blasting or rattling cone-type speaker.
9. It must be capable of satisfactory performance with several makes of parts designed for similar use.
10. It must not require critical grid condenser or grid-leak adjustment.
11. It must have no more than three tuning controls.
12. It must permit the use of voltage up to 120 on the audio amplifier tubes (though less may be used if desired.)
13. The plate current consumption of the four tubes (measured at normal filament voltage) must be less than 10 milliamperes, when storage battery tubes are used.
14. It must be capable of exceptional long-distance reception, with volume sufficient to fill a good-sized living room.
15. It must be simple to operate.
16. It must be free from hand capacity.
17. No shielding is to be used.
18. It must be capable of loud speaker operation on two tubes.

HOW THE TEST WILL BE MADE

At least three judges will be employed who will be capable of passing on the over-all quality of the receiver.

The test will be made on the following points:

Volume on local stations

Tone quality on local stations

Selectivity, judged by ability to cut out locals and bring in distant stations

The receivers to be tested will use an identical set of batteries and antenna and ground equipment, provided with a switching arrangement by which first one receiver then the other may be put in use.

The test of volume on local stations will be the last, and immediately following it, without any adjustments being made, the judges will measure the filament voltage and plate current of both receivers and satisfy themselves of the comparative merits of each with particular regard to the items covered in the specifications. They will allot five points in favor of the receiver showing up better in each of these particulars.

Five points will be allowed the receiver producing greater volume (provided specification 6 is abided by).

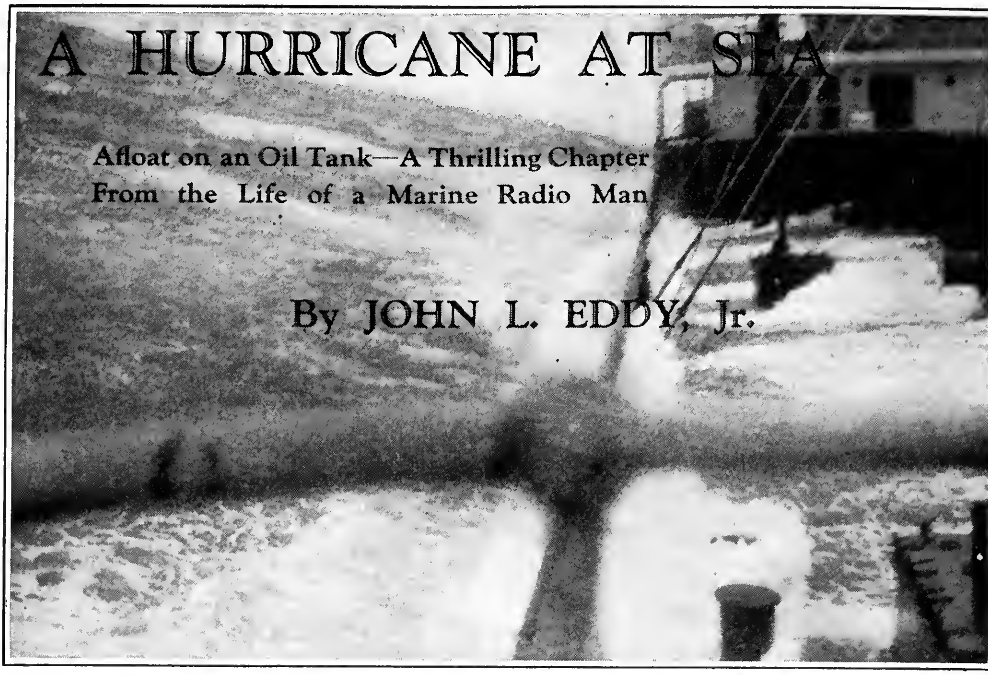
Five points will be allowed for better tone quality.

Five points will be allowed for selectivity.

This offer is made to the advocates of receivers for home construction only. Those of standard manufacture are not to be considered. Manufacturers may later want to establish a similar method of proving the all-around utility of their products. We have no desire to compete with them.

If a receiver is found, which proves better than our four-tube Knockout, it will be worth a lot to us to be able to present the design to our readers, which is what we will do if some one can show us such a receiver.

IMPROVEMENTS in radio circuits from the point of view of genuine technical advances come from the engineer and the research man, who are aided by the resources of their technical training and knowledge. Very few real technical advances have been made by the comparatively untrained amateur experimenter in radio, no matter how extensive his experience. And when the amateur increases his knowledge and technical experience to a great degree, he then becomes a professional. The editors believe that fundamental new discoveries in the radio art will come from the research laboratory, but there is always the possibility that some private investigator may chance on an improvement in construction and design that will prove revolutionary. We know that great numbers of radio enthusiasts are constantly experimenting and it is quite reasonable to expect that some of them may chance on a discovery with decided possibilities. Radio Broadcast wants to find that discovery and wants to turn it to the benefit of those who build radio receivers in the home workshop. The prize contest which is announced in the accompanying article is open to everyone. It should be remembered by all those who wish to compete that the improvement must be of unquestioned value, for nothing else will be considered.



A HURRICANE AT SEA

Afloat on an Oil Tank—A Thrilling Chapter From the Life of a Marine Radio Man

By JOHN L. EDDY, Jr.

THE new radio operator was hungry. A vessel alongside the next dock had parted her moorings and swung around to ram its neighbor. In short, a squall was blowing in the Erie Basin, Brooklyn—where the *Elisha Walker* lay, cleared for Mexico and ready to sail any minute—five-o'clock dinner was being served aft, across two hundred feet of deck, and the new wireless operator wasn't going to get himself wet! In fact he remembers exclaiming to himself fervently "Thank the Lord, we aren't out at sea in this!"

That, as I say, was a squall, as such may be had off the Brooklyn Flats.

A few weeks later the *Arabic* battled for her life; the *Nordfarer* lost her bridge—and her skipper—who happened to be at duty on this bridge; the *Delaware Sun* stood by a foundered schooner; a man was blown bodily from the flying bridge of the *Cerro Ebano;* and so on down the line. For forty minutes the *Elisha Walker* was in the actual storm center of the hurricane, and, well—the wireless operator got wet!

There is little pointedly thrilling in the life of the single operator carried by cargo vessels in ordinary times of fair weather and usual routine. He turns out in the morning when his inclinations dictate, which is anywhere from five o'clock to noon. If he has copied press from the high-power, long-wave stations at Washington, Cape Cod, or Colon, perhaps he types up a wireless newspaper for the captain and the different messrooms. Then he may pick up a weather bulletin. Often, however, he does not do so much in the way of work as to start up his motor-generator during the entire course of morning and afternoon. His life is one of long lazy days, of sun-swept seas, of skies only less blue than the mazarine waves they dome, and nights made up of tropic stars and the gentle swish of ocean against the on-going hull of the ship.

But such idyllic weather as this did not last forever with the *Elisha Walker*. No indeed!

At seven-thirty in the evening of the twenty-fifth of August last I unsuspectingly went on watch after a dozeful intermission of several hours. It was the wireless telegraph which first gave us an idea of what we were in for.

I put on the phones. The receptor was tuned to the usual ship's wavelength, 600 meters. A ship was sending out a report of its local weather conditions. First came the latitude and longitude, which I recognized as indicating a point some sixty miles south of us. (We were then nearing Cape Hatteras.) "Wind force eleven." Twelve is as high as the wind force code goes! Next came "Mountainous seas." The ship with which the first was communicating answered in a whistling

note slightly fainter than the first ship. Her latitude showed her to be some thirty miles south of the first. The operator spelled out the intriguing reply, "Conditions here same as yours, only wind is terrific." The great hurricane which had lain off to the east had looped around and was running to the north and northeast. However favorable our local weather conditions might be a few short hours' run to the south of us the seas were "mountainous", the wind "terrific."

A copy of these intercepted messages I took up to the skipper.

"SEAS MOUNTAINOUS; WIND TERRIFIC"

AT EIGHT o'clock the first mate came off watch and I went in to play the usual evening game of chess with him. Said he at once, "You scared the dickens out of the Old Man, Sparks." I did not understand until the mate added, "He came up on the bridge with those messages you gave him. When he called me he was stuttering; when he handed me the messages he could hardly talk." This was Captain Prager's last trip after half a century of sailing the seas.

As the mate finished speaking, there came a grand crash on the deck overhead, the whole great frame of the vessel quivered and moaned, and down through a ventilator shaft in the middle of the ceiling of the mate's cabin poured a deluge of salt water. The mate seized a pail from a corner and held it up to intercept the flow.

When the chess game was over I went again to the radio to see what the wild ether waves might be whispering during a sure-enough hurricane.

But by this time wind and waves had worked themselves up to a rampant fury, and before putting on the phones it was necessary to "make fast" such movable objects as typewriter, table, and pails, to keep them from skating about the cabin.

I donned the phones, and had heard a medley of loud and faint buzzes, when, in a trice—everything was dead silent! The antenna carried away! In a raging hurricane and out of touch with ships and shore! With a great shuddering lurch of the vessel and a tremendous sobbing crash that rose above the yowl of the wind, several thousand tons of water struck the deck outside. At the same instant the radio signals broke in again as strong, and as reassuring, as ever. This happened more than once. The simple-enough explanation was that the waves were coming in a mass clean across the waist of the ship, wrapping the lower end of the lead-in wires in a solid bank of salt water, which naturally grounded the antenna to the ship's hull and the ocean, and so completely killed all signals.

Towards one o'clock the ether grew quiet; there was little to be heard but two or three ships exchanging weather bulletins, an operator who had missed the United States Navy stations' weather broadcast requesting it from one who had copied it, a Dutchman with weird-sounding spark calling a coastal station a thousand miles away, the ceaseless crackle of atmospherics. I was sleepy, very sleepy. I decided to turn in.

But in this pleasant ambition I was sadly disappointed. How such a quantity of water as I discovered contrived to get into my bunk must remain a mystery!

"PRETTY THICK"

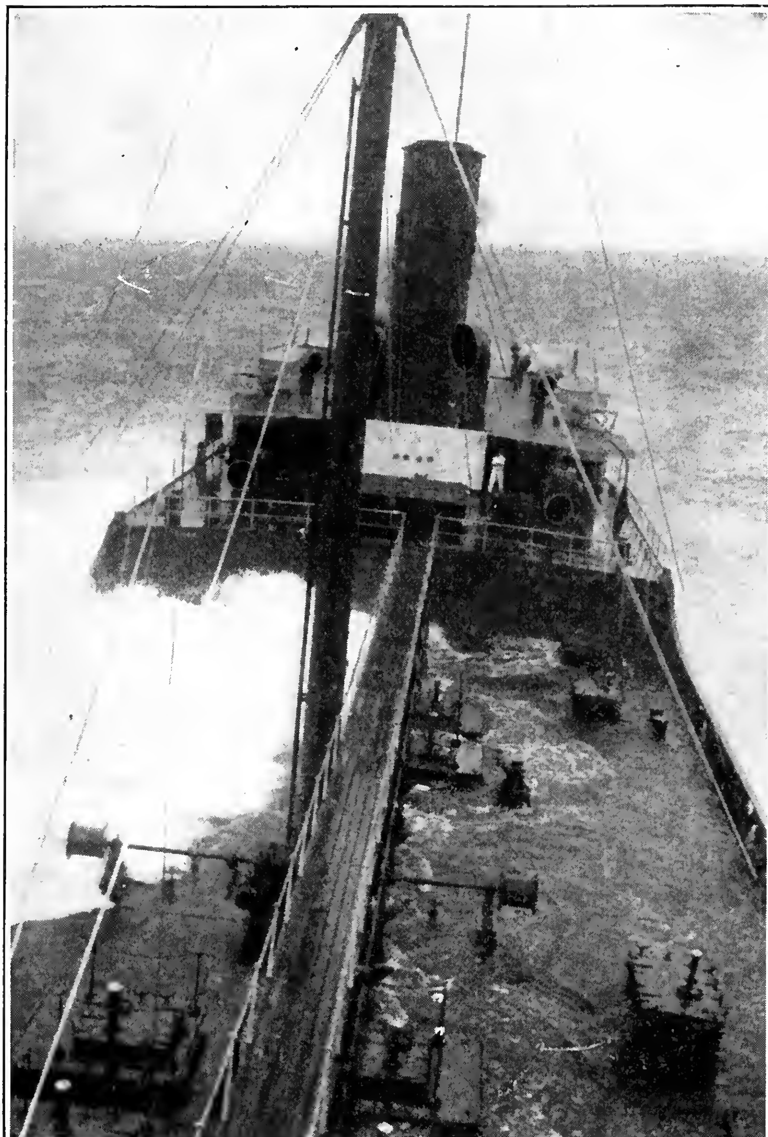
DISCOURAGED thus, I turned again to the radio. The *Munargo*, with tiresome repetitions necessitated by the heavy static, was handling traffic with the station at East Moriches, Long Island. This out of the way and the air clear again, the English-speaking operator on the Danish steamship *Nordfarer* called me and asked how the weather was with us. I gave him a detailed report, adding the words "Pretty t-h-i-c-k," with the dots and

Those Dots and Dashes

Which come through the loud speaker of many a broadcast listener's set on nights sometimes stormy and sometimes clear are often freighted with more meaning than their calm spacing indicates. Those new to radio are too prone to think that "radio" refers solely to broadcasting. But there is more to radio than that. Ship and land stations throughout the world are day and night carrying on their business by means of the same medium that brings entertainment to so many of us. Much of this radio telegraph traffic is workaday and routine, but when the emergency arises, radio is there to meet it. There are few radio men—"Sparks" as they are invariably called—who can not spin a yarn or two of radio and the sea well worth the hearing. Mr. Eddy's story gives an interesting and a true picture of an experience which is certainly not unknown to the marine radio operator.—THE EDITOR.

dashes dragged out for emphasis. At this two other ships put in the universal radio signal for a laugh—four dots and two dots—and the Dane returned a snappy "Thick, did U sa?!!!" The exclamation marks were emphasized. He followed them with a "Ditto here, OM." (OM: radio for "old man".)

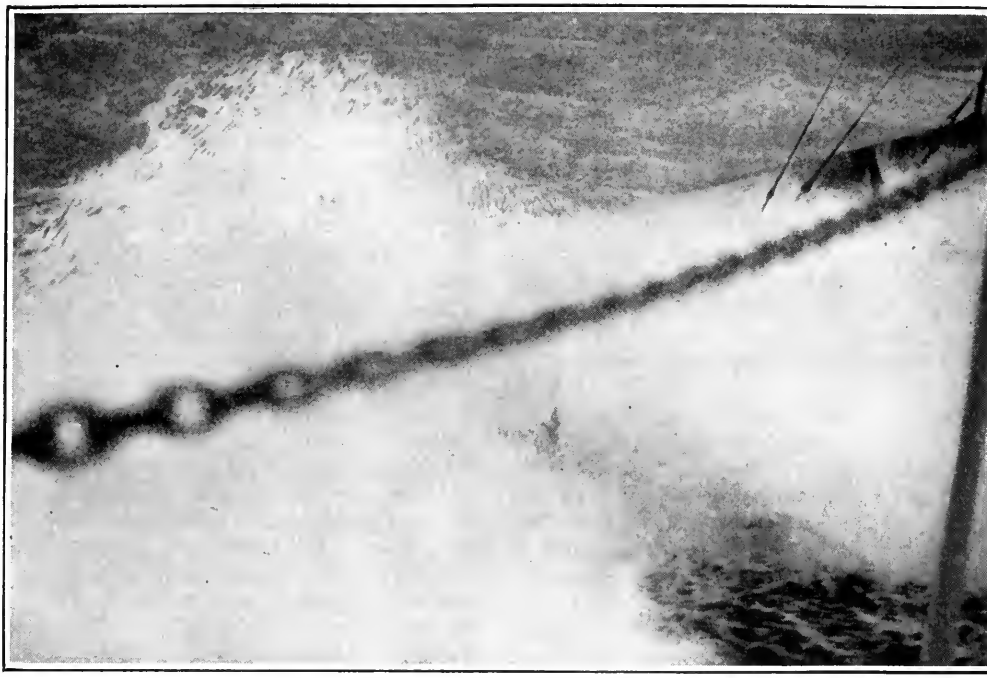
Late the next day it was that this same operator called me with a long "service message" telling of their bridge being taken away at midnight by the wind, and the skipper along with the bridge. The operator wanted to know how to go about getting a radio compass-bearing for his ship, which was now without navigating charts and had been without a "sight" on the sun for the past five days. They had no idea of their position. When the operator had been talking to me the night before, his captain had been drowned more than an hour, but so mighty was the storm that the operator was as yet unaware of the disaster it had worked to his own ship.



"THE HURRICANE HAD SUBSIDED . . .
And the sun was shining through scudding clouds." The radio cabin of the ship was located at this end of the flying bridge, which is the narrow passageway in the center of the photograph

Finally I took off the phones, put the A batteries on charge, and curled up on the narrow settee, still mysteriously dry, with my feet hanging over. I took care to brace myself in such a way that despite the violent movement of the ship I could remain on the settee without particular effort and without wobbling too much for sleep. The wind was screeching, groaning, bellowing, like some vast giant in alternate agonies of pain and rage. Already half asleep, I flattered myself that I had been listening-in on such stuff as the broadcast listeners about their snug hearths ashore could never hear.

I dozed off and slept while the *Elisha Walker*, some two score



THE SEA AND THE SHIP

Amateur photography is a bit dangerous aboard ship during a hurricane and this view was taken by the operator of the *Elisha Walker* after the storm had abated enough so that the radio cabin door could be opened. The chain is the hand-chain of the fore-and-aft bridge. Just above it, the ship's rail is discernable through the flying water

miles off Cape Hatteras, passed through the very center of the hurricane.

THE CENTER OF THE HURRICANE

WHEN I awoke at five-thirty, the impenetrable shrieking blackness of the night before was the least bit less black with the rising of a sun somewhere in heavens far, far off and above the howling watery inferno in which we still weltered. We were passing out of the nearly breeze-less area at the widening center of the cyclonic storm and into the very worst part of it again. Government meteorological observers have estimated the wind velocity at this part of a hurricane to be as high as two hundred miles per hour. At any rate, it blows hard. The barometer, ususally about thirty-something, and reported by the press as down to 29.42 and the lowest recorded in four years, read on the bridge of the *Elisha Walker* 28.65! There was a feeling in one's ears as when climbing a mountain—a hollow sort of pressure distending the ear drums.

Gigantic seas hid the ship, often flying over the top side of the antenna, making it impossible to discern the after lights and funnel from the bridge, even occasionally hiding the foremast from the view of those on duty in the wheel house. To walk down a narrow alleyway was an acrobatic stunt, and the excessive exercise gained in a little such walking impressed itself on arms and back and thighs with a soreness which lasted several days.

After half a cup of strong coffee in the pantry I returned to the radio cabin. The naval station at Norfolk, Virginia, was "coming in" extraordinarily loud. I talked with their operator for a minute, then started for the bridge with the idea that the offer of a radio compass-bearing might not be unwelcome, for only an unreliable approximation of the ship's position could be reached by dead reckoning in such weather, and of course no observation of the sun had been possible in the past few days.

No words could possibly describe the terrific, the awful, composition of sound and movement which struck one coming up the steps into the chart house of the *Elisha Walker* in the early morning of the twenty-sixth of August. As a comparison I see a small box-

like room, gained by a flight of stairs, the walls lined with small black-paned windows, a dim light focused over a broad chart on a high table at one side, the whole chamber jumping and rushing through a violently convoluted path. Just beyond the thin walls a thousand demented devils are making a frenzied onslaught against every square inch of outer surface. That the thousand devils are nothing more than the rapid movement of thin air is merely inconceivable; but it is so. Ask the lookout on the weather side of the bridge if it be not so. He had his very trousers stripped from his legs by the hand of this unseen giant.

After a shouted conversation with the captain, I returned to the radio, only to find that in the interim a sea, finding the transmitter, had drenched the inductances and put it out of commission. Attempting to clean the salt water from between the numberless turns of shiny copper ribbon availed only to get the operator a fall and a bloody contusion on the hip. Until the seas went down—to the extent of no longer keeping the transmitter under a continual shower—all efforts were futile. The *Elisha Walker* was out of communication with other vessels and with the shore; the ship's position could not be ascertained.

THE STORM ABATES

IN A few more hours we saw that the storm was perceptibly abating; but the wind was still blowing at a velocity in the neighborhood of one hundred miles an hour, and great seas were still sweeping across the ship to mingle again with the ocean on the lee side. From seven-thirty to eight, breakfast was being served aft; so with the second mate's oil skin, sou' wester, and hip boots I fared forth to cross the flying bridge. It was no mere blow in New York Harbor now, but the fury of a mighty storm on the high seas that one bucked as one fought one's way down the narrow bridge which leads from amidships to the poop deck of an oil tanker. "Fought" is a suitable word, for it was as if ten men, grasping every part of body and clothing, were wrenching loose your grip on the hand chains to toss you over the side to Father Neptune.

In spite of this zestful prelude, my breakfast appetite, I confess, was not of the heartiest; though I made up for it a few hours later. By then the gale had subsided to a strong wind, the sun was shining through scudding clouds and mist sufficiently to permit an observation. A day or two later, with a life boat stove in, two-inch planking blown away, most of a large metal speaking tubing carried away, and the rest bent to fantastic shapes, the *Elisha Walker* steamed in the early forenoon sun up Ambrose Channel and into the port of New York.

As sang Chief Engineer R. C. Waite in his seafaring barytone,

"Oh, it ain't gonna rain no mo', no mo';
It ain't gonna rain no mo'!"

HOW TO CONSTRUCT A RADIO-FREQUENCY AMPLIFIER

WILL be the subject of an excellent construction article which will appear in an early number of RADIO BROADCAST. A tuned radio-frequency amplifier to meet the requirements of present-day broadcast reception ought to contain inherent neutralization or some means, either mechanical or electrical, to balance the circuit and prevent radiation. The circuit to be described employs two stages of amplification and the famous Roberts method of neutralizing.

The Beneficent Results of Broadcasting

SOME few weeks ago, the amiable Mr. Frank Sullivan, a special feature writer and well-known wit of the New York *World* paid a visit to the microphone of station WGBS in New York. Seldom has the clear cold light of reason been so thrown on individual reactions on the "Great Experience"—which, six years ago perhaps was the War, or facing the minister with one's bride. But now, we fear, the "Great Experience" is broadcasting. An experience it is, too, and perhaps more of an experience for the listener than the performer. Very shortly after appearing, Mr. Sullivan recovered enough to write the following testimonial for broadcasting which was printed in Heywood Broun's column "It Seems to Me" in the New York *World* (copyright, 1925, by that paper):

"I have a message for you from Mr. Eduard Lippe and Mr. Thurston Macauley, two of the most estimable gentlemen who ever made my lot an easy one at station WGBS last Tuesday night," he writes. "They want you to come and broadcast from their station. Take my tip, by all means do it. I did for the first time last Tuesday night, and since broadcasting I have been a different man.

"Before broadcasting, I had that achy, tired feeling all the time. I didn't want to get up in the morning. It was an effort to drag myself to work. I had spots before my eyes, spots on my vest, vertigo, malaria, pyorrhea, mitral insufficiency, endocarditis, acne, dipsomania, Argyll Robertson pupil, acute arnica, alopecia, migraine, megrims, and paronychia. To-day all I have is spots on my vest, and I feel I owe it all to that wonderfully tonic experience of broadcasting.

"You will be frightened before you go on. I walked around the block at Gimbel's four times before I had the abdomen to go up and face the music. But, as I told my dear radio audience, I comforted myself with the assurance that by no possible means yet known to science could they throw anything at me.

"Dr. Paul Sifton, radio editor of the *World*, was a great help. He advised a good sleep in the afternoon preceding the ordeal, so I slept carefully all day Tuesday. I rose at 6 and breakfasted lightly on a steak, with a few lamb chops by way of vegetable, and a sirloin of beef for dessert. I took no stimulants whatever with the exception of three or four cups of coffee with brandy in them. It is best to avoid too much stimulant on such occasions.

"Then I put on a good heavy sweater and a rubber suit and ran from 105th Street to West Fourth and Perry. Whose place should be at that point but the dry cleaning establishment of my old friend, Sir Lucius O'Connor, whom John Masefield had the honor of working for as a barkeep in the old days, when Sir Lucius kept a dry cleaning establishment on Sixth Avenue. Several hours later, having worked up a perspiration, I had a good rubdown and massage, and then Dr. Sifton, after applying the stethoscope to Mr. Macauley and Mr. Lippe, said he thought I was fit to take the air.

"I was frightfully nervous, I can tell you. My heart was bumping like a Broadway surface car going over the crosstown tracks at Times Square. Dr. Sifton administered a hypodermic and gave me Marsh's test for arsenic. I felt better. Mr. Lippe asked me if I thought I could go ahead with it. I said 'Damn the torpedoes. A Sullivan never retreated from a microphone yet.'

"Dr. Sifton gave me the Shick test then, and I sat down. Immediately I had faced that modest little disc, so fraught with mystic, hidden possibilities, and visioned that vast invisible audience outside, something stirred within me and a mighty surge of emotion swept over me. I want to tell you, Broun, that at that moment I was proud of America, and proud to be an American.

"From that moment on I was sure of myself. I had all the calm of a man whose tooth is being extracted. Mr. Lippe said, 'It's all right, I don't think anybody is listening. Go ahead.' So I did.

"I had a splendid time, and I do want you to have the experience. WGBS has had 103 letters lauding my speech. If they haven't got the letters, then I must have forgotten to put stamps on them."

Essential Radio Accessories

A Brief Discussion of Radio Components of Great Importance in Receivers—Constructional Ideals and How They Are Attained—A Bibliography of Radio References

WHAT MAKES THE WHEELS GO 'ROUND: XII

BY WALTER VAN B. ROBERTS

IN THIS last installment of Mr. Roberts excellent series of explanatory technical articles, the reader will find nothing that is new or revolutionary. He will find, however, a splendidly clear treatment of important radio fundamentals put in simple and direct fashion. And, too, many radio experimenters who have come in the art with broadcasting, but who want really to increase their technical reading, will do well to observe the bibliography recommended by the writer on page 1114.—THE EDITOR.

IT IS easy enough to stick a megaphone on to a receiver that produces a loud signal. Most loud speakers are merely refinements of this idea. The horn concentrates the sound somewhat in one direction and the tapered column of air that fits up against the small receiver diaphragm at the small end and swells gradually out to join the open air at the flared end, supplies something for the diaphragm to work against. It makes the diaphragm set more air in motion, just as if a bigger diaphragm were used, thus increasing the volume of sound produced. But inasmuch as the best receivers are only about two per cent. efficient (that is, of 100 units of electric energy entering them only about 2 leave in the form of sound energy), only small efficiencies are likely to be obtained even when horns are coupled to the diaphragm. It is interesting to note at this point that the great sensitivity of the human ear tends to make up for the inefficiency with which energy is converted from mechanical to acoustic by means of vibrating bodies. In ordinary speech only about one erg (the erg is the physicist's unit of energy) per second is converted into sound energy. How little this is can be seen from the following calculation: reckoning that the average human being talks the equivalent of two hours steady talking per day, and that the average population of the United States since the Revolution is forty million, and that power is worth two cents per kilowatt hour, then from the energy point of view all the talking that has been done in the history of our country is only worth $8.59.

86. THE IDEAL LOUD SPEAKER

IN ADDITION to the low efficiency of the conventional loud speaker, there is more or less distortion introduced in this method of making radio signals audible by the horn. An excellent method of overcoming this is by the use of two or three separate horns, each with its own diaphragm. In the case where three are used, for example, one is a very long horn that responds well to low tones, the second is an ordinary sized loud speaker responding fairly well over the middle range, and the third is a very small horn giving the very high pitched notes. The three horns, all working at once, combine to give a satisfactory uniform response over the whole audible range. The three horns, of course, are combined in a single box. The long horn can be coiled to save space if necessary.

Another type of loud speaker avoids such distortion as is due to the horn by using no horn at all. This type of speaker usually, but not necessarily, has a large, light, stiff paper cone for a diaphragm, and this alone is sufficient to give it a good "grip" on the air. At present only a few commercial types of loud speakers give any sort of an approach to the goal of quality, which is to have all frequencies transmitted from speaker to listener with equal efficiency. (It would seem that this goal could be easiest attained by letting the faults of one part of the apparatus cancel those of another part. For instance, if an audio amplifier favors the lower frequencies and the loud speaker gives the loudest response at the

higher frequencies, then the combination of these two units would offer a nearly uniform response over the entire range. But then parts would not be interchangeable, so the endeavor at present is to make each unit, independently of the others, possess a "flat" characteristic, that is, to handle the whole necessary range of frequencies with equal efficiency.) The average amateur can build himself an amplifier that will operate a cheap loud speaker with passable quality and enough volume for a small quiet room, but if he wishes enough volume for a large audience, together with the best quality of music and "articulation" (intelligibility), he should buy or build a first class push-pull amplifier which can be used with a loud speaker unit, or amplifier using power tubes and use it to feed a high quality loud speaker such as those described above.

87. DRY CELLS FOR A BATTERIES

WHEN only a watt or less is required to heat the filaments of all the tubes of a receiving set, it is often simplest to use the standard six inch dry cell. The voltage of a dry cell is between 1½ and 1 volt according to its condition. To get the most, in the long run, out of such a cell, not more than about ¼ ampere should be allowed to flow through it. Hence we should not figure on obtaining more power (volts times amperes) than about ¼ watt per cell. Thus a single tube requiring an ampere at five volts (five watts) for its filament would require about 20 dry cells to run it for any length of time. On the other hand, the Radiotron UV–199 tube needs only .18 watt (60 milamperes at three volts) for its filament. Two dry cells in series, or, better, three in series with a controlling rheostat, would take care of three such tubes easily. The WD–11 or WD–12 tube runs on ¼ ampere at 1.1 volts. It is obviously designed to run on a single dry cell.

88. RADIO TUBES

THE tendency in tube design seems to be toward very small tubes (requiring very little filament battery energy) for handling small amounts of alternating current power. At first the filaments of vacuum tubes were made mostly of tungsten, a metal which gives off a good emission of electrons only when very hot, and the tungsten filament still in use in the Radiotron UV–200 "soft" detector tube requires five watts to heat it. The Western Electric Company reduced the power required for their filaments by making them of platinum coated with oxides of barium and strontium which give a good emission of electrons at a dull red heat. The WD–11 and WD–12 tubes of the Radio Corporation of America have filaments of the same type. The next step came with the discovery that if a little thorium oxide is mixed with the tungsten of a filament, upon operating the filament, pure thorium works its way out of the filament and coats its surface, as a result of which plenty of emission can be had with the filament running much cooler than when the surface is tungsten. If one of these thoriated filament tubes is run at more than the rated voltage with the idea of increasing the emission, the thorium surface is likely to boil off and then the filament will be no better than plain tungsten until the thorium surface is renewed by letting the filament run a while at rated voltage with the plate battery disconnected. The Radiotron 201–A is a tube having this type of filament and takes ¼ ampere at 5 volts and while it is a good detector and amplifier of weak currents, its advantage over the 199 is chiefly its ability to handle larger amounts of power, such as for a loud speaker. The Radiotron 199 also uses a thoriated filament but takes only .06 ampere at 3 volts, or only .18 watt. Its grid and plate are so small that the resulting reduction in grid-plate capacity makes it less apt to oscillate in radio-frequency amplifiers.

The next advance was the discovery that by special means caesium could be made to coat tungsten filaments. And caesium gives a good emission at the lowest temperature of any material known.

It is probable that before very long the tubes for radio frequency amplification and detection will be as small as one's little finger and many of them will be run on a few dry cells, and, last but not least, quantity production should bring the price down to a fraction of what we now pay.

89. DESIGN OF GOOD ACCESSORIES

A VARIABLE condenser that makes horrible noises due to short circuits or bad contacts with the rotating part, or is hard to turn, or that isn't balanced so as to "stay put," or that does not have the same capacity every time it is turned to the same setting, or that has lost motion or looseness in the knob, or that hasn't some satisfactory means for very fine adjustment, is enough to take all the pleasure out of a radio set. For a while, very few really good condensers were available to the radio public. Now, there are a

considerable number available of good construction. It doesn't pay to save money on the tuning condenser.

90. SOCKETS

ANOTHER point where trouble is likely to occur is in the tube sockets. The springs that make contact should be long, and made of several laminations so that they won't be permanently bent by pushing the tube into the socket. Poor contacts in tube sockets cause a lot of "unexplained" noises. The socket should also be made of a good insulating material. Hard rubber, porcelain, pyrex glass, and bakelite are good but many of the fiberous and moulded materials are not.

91. CONTACTS

GOOD contacts throughout a set are essential. All contacts should be soldered, or else a good clean wire clamped firmly by a binding post or Fahnstock clip. Poor contacts are responsible for so much of the trouble that arises in receiving sets that it is worth while to guard against them with what might seem unnecessary care.

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What Radio Equipment Does the American Fan Use?

An Analysis of the Apparatus Used by Listeners Who Heard Europe in the International Radio Broadcast Test

By HAROLD S. FRAINE

WE ASKED a deep-dyed radio fan what he thought the recent International Radio Broadcast Test had proved to him.

He grinned. "Well," he rejoined, "it proved that there are a lot of fatheads like me who sit up all hours for the privilege of discovering that if he owns a radio set in New York one can hear a radiating rodeo rider as far away as Denver."

The Test did prove this in a sense. We found beyond doubt, that the million squealers who tantalized their dials during this time are the chief obstacle to distance reception. The tests led one to think that multi-tube sets are no more likely of success in distance angling than expensive tackle is the paraphernalia of success for a man who angles for fish.

It proved that the successful ten-tube sets strung end to end wouldn't reach to first base. It proved that Willie's one-tube set was ten times as effective as the multi-tube sets, and this is immense encouragement to the Willies until you examine the numbers of them, and discover where they live.

There are at least as many one-tube sets, as for instance, seven-tube outfits. And when one remembers that the multi-tube sets are preponderantly owned in big towns where the money to buy them is more plentiful, where folks stay home less because of the big town's amusements, and where the lust for entertainment is overwhelmingly greater than the lust for distance; if one remember these things, one wonders if Willie deserves the distinguished service medal after all.

The Facts in the Case

At various times in recent radio history—and all radio history is really "recent"—various agencies have collected statistics about the radio public. But most of these surveys, perhaps made for a particular purpose, were necessarily limited in their scope. Mr. Fraine, a member of RADIO BROADCAST staff, has examined the interesting questionnaires returned to the magazine from thousands of radio listeners in every part of this country and others, who reported hearing foreign broadcasters during the International Radio Broadcast Tests of last November and December. It is not incorrect to assume that those who returned their answers represent a very fair cross-section of the American radio public. We can judge from what they say what kind of radio equipment is most popular, and if we be of an analytical turn of mind, we might make a very fair prediction of the trend of radio. Are home-built or complete, purchased receivers more popular? Do listeners favor storage or dry cells? The author has tried carefully to draw reasonable conclusions about these, and many other, interesting points.

—THE EDITORS.

Naturally, having sponsored the International Broadcast Test and invested a great many thousands of dollars to insure their success, RADIO BROADCAST wanted to know something about those who achieved the note-worthy end of hearing Europe. We wondered where they lived, what circuits they used, how many tubes were used in their sets, whether they had a long or short antenna, high or low, or a loop, whether DX was picked up with phones, or whether the loud speaker brought it out enough for all to hear, whether they used dry or wet batteries.

The first job was to sort out the answers to these questions as they came to us in the mail, and if you were ever in the unenviable position of having to write down in a few hasty sentences the result of the answers to over forty-six thousand questions, you know that takes a little longer than from yesterday

to to-day. That is why this article is in the April Radio Broadcast and not January.

MANUFACTURED VS. HOME-BUILT SETS

"WHAT is the percentage of manufactured compared to home-built sets?" This question was put to a prominent radio retailer. He leaned back and thought a moment and said:

"I can't answer that question for the whole country, but I do know this. Two years ago, about 85 per cent. of our business was selling parts and only about 15 per cent. of our sales were complete sets. To-day just the reverse is true, and fully 85 per cent. of our business is in the sale of complete sets."

We got a very difficult picture from the questionnaire which reached a very representative part of the radio public. The answers showed that a majority of radio fans still "roll their own"—fifty-five per cent. to be exact. There was every sort and kind of radio mixture you could conceive of and while the table of percentages we made shows only five different essential hook-ups, this number could be multiplied by a hundred and still you wouldn't have all the various "dynes" and "flexes." Some of you will say: "I might as well call my set one of these, as to say all birds are chickens." But in the last analysis, you will find that these classifications are about as good as any:—super-heterodyne, neutrodyne, stabilized radio frequency, reflex, and regenerative, and the greatest of these, as you will see by the table, is regenerative!

The typical regenerative circuit, after all we have said in the columns, must be closely associated in your mind with the radiating bloopers, and our fine argument against regenerative squealers is clean out—out with a knockout blow—down for the count of ten! But not so hasty! Practically every one of these people came right out flat footed and said "no radiation, in the antenna circuit" "extra neutralized tube in the antenna circuit," or something to that general effect. Which goes to prove that a large number of regenerative circuit owners at least know what they are up against, and that there is a fortune for the man who can invent some simple attachment preventing regenerative circuit radiation. In this connection, the new attachment, invented by Mr. Roy A. Weagant, Chief Engineer of the De Forest Company, may prove of great benefit to regenerative set users. The argument regarding the proper use of the regenerative sets seems to have generated more heat than light.

The super-heterodyne, neutrodyne, and the various kinds of reflex circuits divided honors nearly equally among the home built sets, employing not essentially regenerative circuits. There are more than three times as many regeneratives as any of these others. And this means absolutely nothing except that the cost of good home-made receivers, just as with good manufactured receivers, plays a big part in the number that are in circulation.

INTERNATIONAL RADIO TESTS—1924

Name.......................................
Location....................................
Will you accept appointment as official listener in next year's tests?..........................
Type Receiver...............................
If factory made, what kind?.................
If home-made, what important parts?..........
Number of Tubes........Kind of Tubes.........
Antenna or Loop..Length of Antenna..Height...
A Battery. Wet......Dry......Make..........
B Battery. Wet......Dry......Make..........
Battery Eliminator?........What kind?.........
Any special equipment not covered above ....
....
....
What was source of worst interference?...........
....
Next worse source...........................
....
Did you use head-phone or loud speaker?.........
Make of Phone..........Make of Speaker.......
Names of radio enthusiasts having efficient apparatus and who can be recommended by you as official listeners.

....
....
....
....

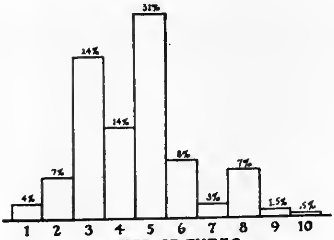
Return to Radio Broadcast,
Garden City, New York.

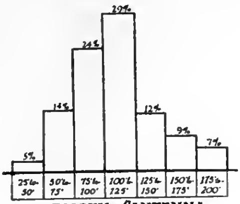
THE QUESTIONNAIRE

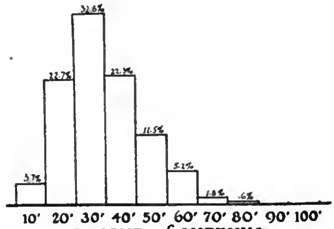
Which was sent to all listeners who reported hearing foreign broadcasts. The information which the answers brought gave a set of facts about radio users which had never been definitely known before

ANTENNA—LONG OR SHORT? HIGH OR LOW?

OUT on the wide expanses of the ocean on sailing ships in fair weather and calm, sailors rig a sail away up on the main mast which they call a "cloud-breaker" or "sky-sail." Its purpose is to pick up any vagrant air current which might help to carry the ship along. But the good ship really depends for its headway upon its broad sails of modest height. In the same way







Manufactured vs. Home-Made

TYPES OF HOME-MADE HOOK-UPS USED IN TESTS

Super-Hetrodyne	16.23%
Neutrodyne	13.84%
Radio Frequency	5.01%
Reflex	15.38%
Regenerative	49.54%
	100.00%

SOURCE of WORST INTERFERENCE

Radiating Receivers	50.7%
Spark Stations (Code)	18.5%
Static	13.5%
Fading	5.3%
Other Stations	5.3%
Man-made Static	5.2%
No Interference	1.5%
	100%

TABLE I

Showing graphically the results of answers to the questionnaire on page 1116. The tabulation shows that of the group answering, 45 per cent. used manufactured sets and 55 per cent. were home made. It roughly classifies the types of circuits used in the home made receiver, source of worst interference, average length and height of antenna and the number of tubes used

radio fans, looking for unusual results, sometimes can afford antennas stuck high in the air, which may pick up stray radio impulses, but the most dependable average good results, it would appear, are obtained from antenna of moderate height and length.

As you will see from the diagrams, the most popular antenna is from 100 to 125 feet long and about 30 feet above the ground. A surprisingly large percentage use an elevation of only 10 feet, and much shorter lengths.

Einstein has secured a good deal of publicity from what is popularly known as the Law of Relativity, which, in our modest understanding, means that anything you think is true, isn't true absolutely, except as it relates to something else that is true. You finish where you started, and then begin all over again!

So with antennas. Anything you think is true about them, isn't true except as it relates to the unavoidable conditions where your particular antenna is located. It is natural to expect that in cities where there is every sort of interference underneath the ground, on the ground, and in the buildings, a high antenna, as far away as possible from the disturbing elements, will be most effective. In the country, where one is far from all disturbances, great heights are apparently not so desirable.

Even these conclusions are relative, for high antennas may collect static and more remote disturbances; long antennas with their inevitable lengthy lead-ins, cut down the selectivity of the receiver. In general these statistics show that for good results from antennas it is not necessary to put them in the clouds.

ANTENNA VS. LOOPS

ONE big quarter slice of pie in the statistics is given to the loop. Think of it! Twenty-four out of every hundred of these people didn't do any tree climbing or roof walking whatever.

"Oh," you say, "but all these people used big and expensive receivers."

Well, let us see. The table showing approximately the "Types of Home-Made Hookups" shows that only 16.23 per cent. were super-heterodynes. And of these super-heterodynes, 44 per cent. use a loop, another 19 per cent. use a loop loosely coupled with an antenna, while 37 per cent. used an antenna exclusively. Really, the users of both loop and antenna should be classed with the antenna users, giving a total of 56 per cent. operating their super-heterodynes on an antenna, against 44 per cent. operating on a loop.

In addition to the super-heterodyne hookup, among the loop users were listeners with neutrodynes, tuned radio-frequency sets and reflex sets. Conspicuous among the loop

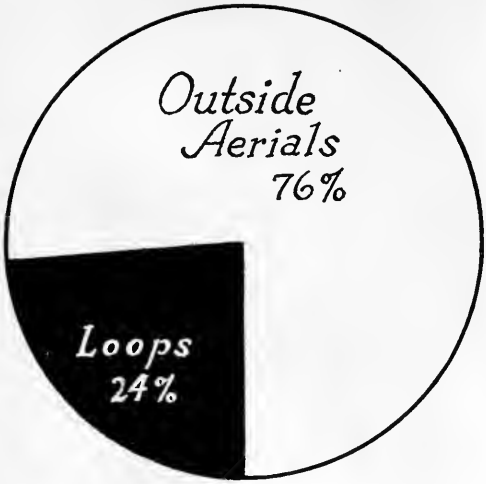


TABLE II
The proportion of the use of outside antennas to the use of loops

users were those who employed one of the special types of reflex. It was a five-tube set.

PHONES VS. LOUD SPEAKERS

IT HAS been said that a large majority of radio owners now use only a loud speaker both for tuning and for constant reception. Our analysis, however, shows quite the contrary. For distance work 54.4 per cent. use only the phones, an additional 29 per cent. use both the phones and the loud speaker, while only 17.6 per cent. use the loud speaker alone. Adding those who use the phones exclusively and those who use both the loud speaker and the phones, we have a total of 82.4 per cent. of set owners who have phones on hand. It may be that in the future we will use only the loud speaker, but, for the present, phones appear to be holding their own. There are still, apparently, large numbers of people who need a good loud speaker.

WET VS. DRY BATTERIES

CONSIDERING the difficulties of charging and the occasional inconvenience of wet batteries, naturally there is a great temptation for many radio folk to use dry cells. One often hears it said that the use of dry cell sets is much on the increase. We have been wondering about this, and so have you, but not until the answers to these questions came to us did we have the lightest inkling of more than a general idea of the real truth. Table III shows clearly the true situation. Here at last we have some knowledge beyond the mere fact that the fewer tubes one uses the less battery required.

AN HONEST RADIO FAN

WE THINK this investigation has discovered for you the most honest radio fan in America. His name is William Samuel Dycus and he lives in Moundsville, West Virginia, He stated in answer to the question, "What was your worst source of interference?" His worst source of interference was *"distance."* A truth which all of us felt, but lacked the candor to admit. While we admire his honesty and admit there is much truth in his statement, neither you nor I would say that distance is truly the real handicap to radio receiving to-day.

The table which is an analysis of the "worst source of interference" shows that practically half give first place to radiating receivers. Other sources play only a small part in the total, while only a few people stated they had no interference whatever.

By the way, you will wonder where the people live who are thus blessed with no interference. Doubtless not on Long Island. or anywhere close to large cities. On Long Island, if the thousands of bloopers were not enough, the code which covers the whole area like a blanket furnishes the rest of the interference. People who live in that area, and there are not a few of them, deserve especial credit to have heard Europe.

Conditions in the cities are in no way comparable with conditions in the smaller towns and in the country. And yet our successful listeners were limited to no special location. There were hundreds within the city limits of New York who heard. The rural sections were represented in almost exact ratio to their population.

Here, however, is a letter from as far West as Indianapolis which speaks more eloquently than any words we could use—with reservations, because naturally we do not admit that the International Tests were 90 per cent. bunk! Anyway, here is the letter:

RADIO BROADCAST,
Garden City, L. I.

GENTLEMEN:

Your secret is out! You disguised it well, but the truth of it has become so obvious during the last few days that there is no further need of secrecy.

Transatlantic Test? Ninety per cent. bunk. Demonstration of the curse of squealing receivers? Ninety per cent. perfect!

We have had several foreign stations on a Radiola super-heterodyne with a directional loop, but at the announcing of the station the squeals have invariably increased until no other sound can be distinguished. I enjoy RADIO BROADCAST as much as I detest "radio broadcast's" evening hour of babel. I understand now how super-power alone can eliminate the squealers. Your demonstration has been a great success, and you have many supporters of your campaign against squealers from this district. Success to you!

Yours truly
THOMAS B. NOBLE, JR.,

We are glad the Tests have served for this incidental good effect.

Perhaps there is some hope in the remarks by Dr. J. H. Dellinger, Chief of the Radio Laboratory of the United States Bureau of Standards, in a survey on Interference released recently by the Department of Commerce:—

The various causes of interference divide into two great classes—natural and man-made. Progress is being steadily made against both of these enemies. As to the natural interference, there will always be a certain residuum of atmospheric disturbances and fading which will necessarily limit the distance from any broadcasting station at which reliable satisfactory reception will be possible. The various kinds of man-made interference, on the other hand, are curable and are of local character; it can be expected that more and more localities will be freed from the various types of this pest.

Increase of knowledge and of practical applications characterize all phases of radio. We are coming to have a picture of the machinery by which the waves are propagated. Remarkable discoveries are being made in the behavior and potentialities of the waves of hitherto unknown frequencies. We are learning to direct the waves in a desired direction. The battle against interference is being won in spite of enormous increase in the use of radio.

AN ENGLISHMAN TUNES—IN

AFTER looking over the letters, which came to us by the basketful from people in all parts of the United States, it was something of a shock to come across one mailed by Arthur Oswald Millne, "Homefleet," Northdown Way, Margate, Kent, England. He heard several of the American stations on a receiver which he called a

"1-V-2 Tuned H F Plug and Transformer L F."

Which translated from Continental radio "lingo" into ordinary "Yankee" means one stage tuned radio-frequency, detector, and two stages of transformer-coupled audio frequency.

"H F" in England means, high frequency or radio frequency "valve" designates a detector, and transformer L F" signifies transformer low frequency or audio frequency.

In answer to the question on whether or not he used a battery eliminator, he said:

"What on earth is a battery eliminator?"

"Do you mean a rheostat?"

Power from the lighting circuit seems not yet to have appealed to the Englishmen.

THE IDEAL RADIO EQUIPMENT

IF WE could take a composite photograph of good radio sets along with their equipment, where we found them all over the country, and somehow visualize for you the kind that was most successful, this picture would be most valuable for every reader of these pages. In a sense the tables shown here do exactly that. They paint for you a picture taken from actual facts. For that reason we believe they are worthy of careful study.

Taking them one by one they form a very useful basis for camparison with the equipment you now use, or suggest the right thing to buy.

First comes the number of tubes used in successful sets (Table I). You will see that the number most frequently occurring is five. You might have guessed that, without having seen these percentages; but would you guess the next most popular number of tubes is—three?

Your ideal set, it would appear, will have either five or three tubes.

This would be very convincing and pleasing, in a way, if true. At least one question about radio would be solved forever, and you

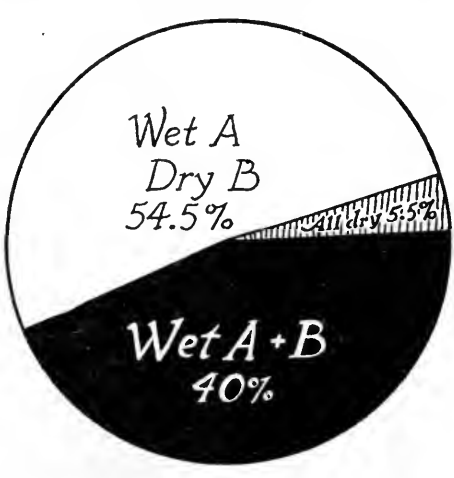
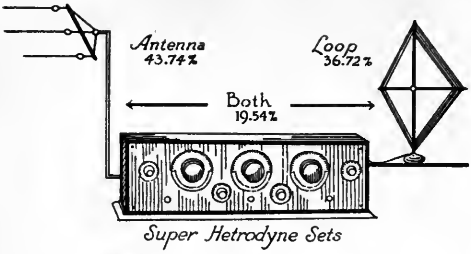


TABLE III
How the current for the radio receiver is supplied by the average user



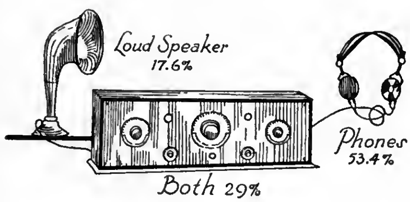


TABLE IV

The top illustration shows how the users of super-heterodynes in the Radio Broadcast survey got their energy from the ether. An unfortunately large percentage used an antenna directly connected to their "super." The lower drawing shows how the users of all types of receivers got their signals. Twenty-nine per cent. used both loud speaker and phones and 17.6 per cent. used the loud speaker alone. These figures, it is true, apply chiefly to reception during the International Test

could sleep peacefully to-night, knowing that your five- or three-tube creation is the set sublime. Herein lie the limitations of an investigation of this kind. Just because a large number of people are successful with a certain number of tubes does not prove that these same people would have gone wrong with a different number of tubes. You cannot prove that all cats have ten tails, because no cat has nine tails, and a cat has one more tail than no cat. Mr. Henry Ford does not necessarily make the best car for all uses because he makes more!

The purpose of these analyses is to suggest rather than to prove. In no place are the limitations of mere figures more clearly shown than in Table I, which shows the kind of hook-ups home radio builders use. Nevertheless the percentages are highly significant as an index to the kind of hook-up in use to-day.

But to return to our ideal set (with reservations), you see from Table I that you have a little better chance of owning a distance-getter if you make your set than if you buy it complete. Here again, on second thought, you will see that if you would rather buy than build, all you have to do is to be careful and purchase the right kind of set. There are more and more good ones being made every day. There is no table showing the comparative ratings of the various manufactured sets used. To outline them would be like trying to itemize the accomplishments of the automobiles of the United States. This book would not hold the complete record, and rather than work an injustice upon set manufacturers we are obliged to leave this interesting part of the story untold.

Our ideal set has one chance in four of using a loop, and if it uses an antenna, there will not be much over a hundred feet of it all told, and it will be from twenty to forty feet off the ground (Table I). It will probably use wet A and dry B batteries, or both units wet, but it has a healthy little chance of being good with all dry cells (Table III).

For "Radio Golf," as Secretary Hoover calls DX, we will surely need a pair of phones (Table IV), And if we own a super-heterodyne, we will have better chances for distance with an antenna outside, although the neighbors may rightly object. The secret being out, we can well conclude by considering the main causes of interference (Table I), which is radiating receivers—those birdies and cat-calls and squawks in the menagerie of din.

"NOW, I HAVE FOUND . . ."

A Department Where Readers Can Exchange Ideas and Suggestions of Value to the Radio Constructor and Operator

FOR a long time, RADIO BROADCAST has felt the need of an outlet for the many excellent ideas dealing with various features of radio construction which reach our office. With this issue, we begin the department of good ideas from our readers, and invite the coöperation of all those who are interested.

If you have an idea about a valuable and useful new circuit, some new device, a construction or operating suggestion, we should like to have it. Payment of from two to ten dollars will be made for every idea accepted. The descriptions should be limited to three hundred words and typewritten. Accompanying sketches, drawings, and circuit diagrams should be as plain as possible.

We do not want simple, obvious suggestions. Material to be acceptable for this department must offer something of definite value to the constructor. Mere novelty is not desired. Address your manuscripts to this department, RADIO BROADCAST, Garden City, New York.—THE EDITOR.

A TESTER FOR CIRCUIT CONTINUITY

I HAVE assembled a very simple test outfit made up from odds and ends around the work shop which helps considerably in determining whether purchased parts and laboratory odds and ends are defective or not. It has also been found useful in testing out radio sets for continuity of circuit, testing fixed and variable condensers for short circuits, jacks and sockets for loose connections, and transformers for short circuits, open circuits, and ground. This test unit consists of a 25-watt lamp inserted in one side of the 110-volt line to which are connected two awls. The test leads are of flexible wire. Two fuse sockets and fuses are inserted one in each side of the line at its input. The circuit diagram is shown in Fig. 1.

The lamp flashes when a circuit is closed indicating that the circuit of the unit tested is continuous. In testing audio transformers, the awl points are touched to the primary posts and if the secondary side is momentarily short circuited, a spark discharge may be observed at its terminals.—F. E. MADDOX, Roanoke, Virginia.

HEAD SET PLUG MADE FROM BROKEN AUTO BULB

SMALL plugs for plugging in radio headsets are indispensable where radio receiver or loud speakers are to be used in different rooms in the house. They can be made for little or nothing, from the bases of burned-out automobile lamps.

To make the plug, the glass bulb must be broken away close to the top edge of the ferrule and the remains of the filament removed from the ends of their coarse wire terminals. Then the latter should be spread about $\frac{1}{2}$ inch apart and thoroughly cleaned to make them bright.

The ends of the wires composing a length of twisted lamp cord are then cleaned and soldered to the two filament terminals. In doing this, care should be exercised not to use too much solder, otherwise there is apt to be a short circuit between the terminals.

Then the terminals are again pressed together so they are nearly parallel. Hot sealing wax is poured between and around them so they are thoroughly covered and imbedded in a solid insulation which completed the plug shown in Fig. 2.

This plug could then be inserted in an auto-

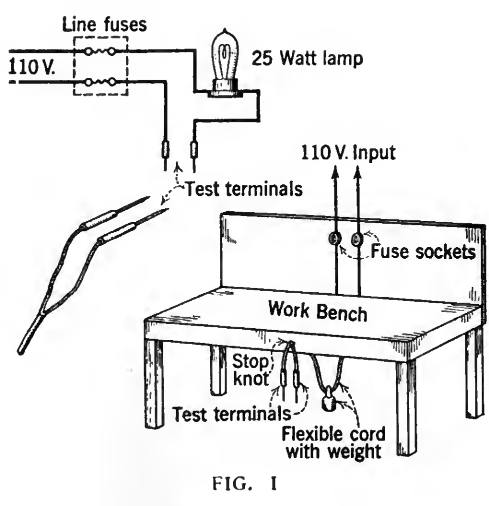


FIG. 1

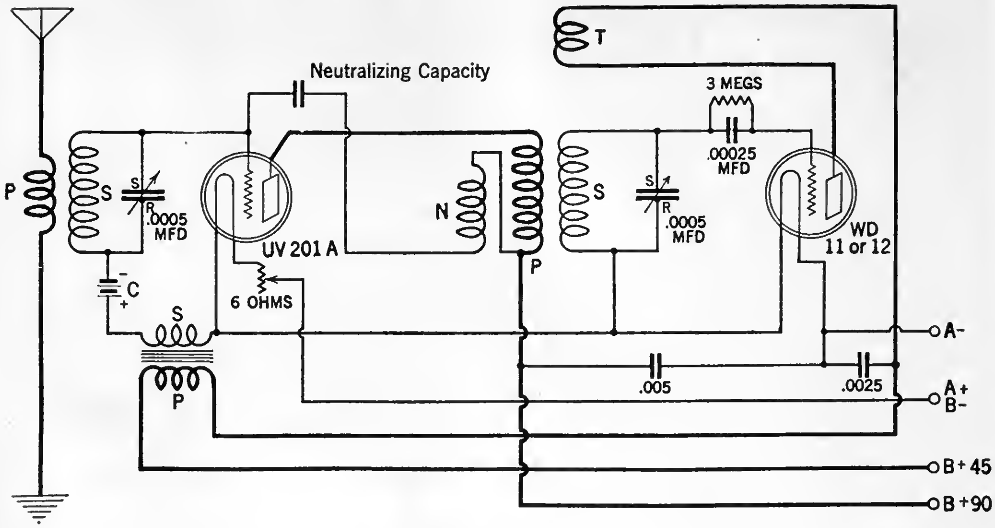


FIG. 3

mobile dash socket placed in a convenient place in the wall. Radio concerts can then be enjoyed just as well as though one were sitting near the receiver.—L. R. ROBBINS, Harwich, Mass.

THE WD-11 IN THE ROBERTS CIRCUIT

THE WD-11 or WD-12 as detector with the 201-A as amplifier is my first choice of tubes for the Roberts circuit. These tubes take the same current and can therefore be used with the filaments in series. This method uses the whole battery voltage usefully in the tubes, reduces the current consumption about 20 per cent. below the 201-A-199 combination (which is quite an item when using dry cells) and in my opinion, based on the operation of a number of sets, is quite as satisfactory.

It also reduces first cost by eliminating the high resistance necessary with the 199 tube, the only resistance used being a six-ohm rheostat, which is not really necessary. However, I have found that most tubes will work as well or better, a little below rated voltage rather than above. With this combination it is impossible to overheat the filaments, giving the tubes a longer life.

This combination is much more stable in the four-tube set than when a 201-A is used as a detector and seems to me to give as good range and volume as when the larger tubes are used throughout. Care should be taken to use bus wire for the filament leads and not less than No. 14 wire for the A battery leads which should be as short as possible as there is no voltage to spare for line loss.

The diagram Fig. 3 shows the slight modification of the Roberts circuit necessary. Observe the changes in the filament circuit, the WD-11 grid return, and the return for the .005 mfd. bypass condenser.—HARDING GOW, East Sound, Washington.

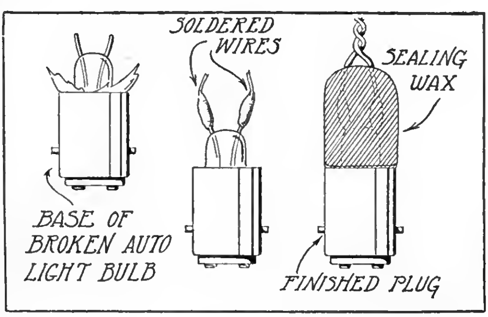


FIG. 2

WHEN YOU WRITE THE GRID

Don't fail to enclose a stamped, self-addressed envelope with your inquiry if you expect a personal reply.

Don't be impatient if you do not receive an immediate answer. Every letter is answered in the order of its receipt. Do not send a second letter asking about the first.

Look over your files of RADIO BROADCAST *before asking a question which might have been covered in a previous issue.*

Don't ask for a comparison between manufactured apparatus. The addresses of manufacturers of articles used in the construction of apparatus described in RADIO BROADCAST *will be given on request.*

Don't include questions on subscription orders or inquiries to other departments of Doubleday, Page & Co. Address a separate inquiry to The Grid.

Don't send us a fee for answering your questions. The Grid Department is maintained for the aid and convenience of readers of RADIO BROADCAST *and there is no charge for the service.*

QUERIES ANSWERED

OF WHAT USE ARE METERS IN A RADIO RECEIVING CIRCUIT?

H. B.—Saginaw, Michigan.

HOW ARE NEUTRODYNES NEUTRALIZED?

L. N. C.—Toledo, Ohio.

HOW ARE PANELS PREPARED?

I. M.—Philadelphia, Pennsylvania.

CAN YOU REFER ME TO ANY PREVIOUS PUBLISHED NOTES AND COMMENTS ON THE ROBERTS CIRCUIT?

C. C.—Chicago, Illinois.

BRIEFLY, WHAT SHOULD I DO TO KEEP MY STORAGE BATTERY IN TOP-NOTCH ORDER TO INSURE PERFECT SERVICE?

J. A. T.—San Diego, California.

WILL YOU TELL ME WHAT WAVE TRAPS ARE, HOW THEY ARE USED AND WHAT ARE THE CIRCUITS?

A. L. T.—Norfolk, Virginia.

METERS AND THEIR USES

THE inclusion of voltmeters and ammeters in a radio circuit is desirable but not always possible because of their cost. Meters offer a definite check on the condition and operating efficiency of the batteries used with radio receivers. Those who can afford these luxuries may well make this addition to their equipment.

A plate milliameter with a full scale range of 0 to 100 milliamperes such as the Weston type 301 is admirably suited for the purpose of determining the rate of current flow in the B battery circuit. In other words, the amount of current the entire set is drawing in milliamperes may be determined.

A correct reading of the voltage of the B battery is also desirable so as to determine the state of its life. When a battery drops in voltage below two thirds of its rated voltage it is ready to be junked. B batteries whose voltage is low mean weak, distorted signals.

The use of these two meters is clear when the following explanation is considered.

B batteries have a certain period of life. As in the case of the storage battery as described in last months' GRID, this life is rated in ampere-hours, only in B batteries the rating is a fraction of the larger filament batteries and is rated in milliampere hours. Explained, this means that a certain amount of current in milliamperes may be withdrawn from

the battery over a certain period. Applying values, a 4500 milliampere hour B battery may theoretically be discharged at the rate of 45 milliamperes for 100 hours. As this discharge takes place and the capacity of the battery is reduced, the voltage also decreases.

The use of the voltmeter and milliameter is quite evident in determining this condition.

Some may wish to mount the meters permanently on the panel of their receiver.

In the case of the voltmeter this may well be a double reading scale covering both filament and plate voltages. By means of a double-pole double-throw switch, this voltmeter may be thrown from one circuit to the other. Excepting for momentary B battery tests the voltmeter should be thrown over to the filament side. See Fig. 1.

The milliameter may be inserted in series with the negative lead of the B battery line. In this position it will register the total detector and amplifier tube drain.

However, for the true experimenter, this plan is not economical or entirely efficient since, on the building of other circuits it will necessitate the tearing out of these meters from the previous circuit.

A better way is to mount these meters on a special panel with the necessary clip leads attached. Then temporary tests may be made with any circuit. See Fig. 2.

The use of a voltmeter in a super-heterodyne, either of the manufactured or home-made type deserves special notice not related to the above discussion. Tubes have a definite voltage rating specified by the manufacturer. For the good of the tube it is well not to exceed this rating. A voltmeter is the surest check-up.

NEUTRALIZING SYSTEMS

THE selection of a system for obtaining neutralization in a tuned radio-frequency amplifier depends largely upon the circuit employed. To qualify this statement—a circuit embodying a reflex system could not be neutralized by the standard neutrodyne method because in removing the tubes, one at a time, the audio frequency circuit would be broken, which would prevent the audio signal from being heard in the phones.

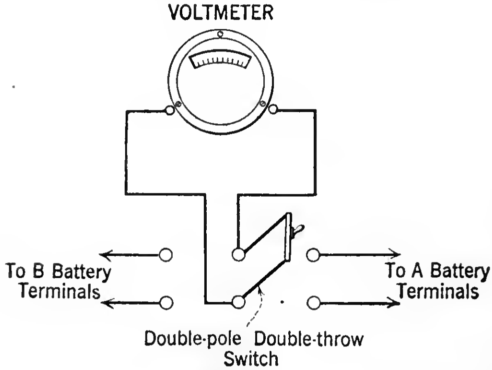


FIG. 1

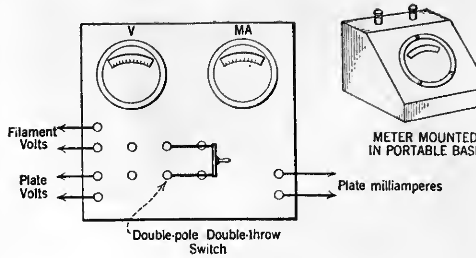


FIG. 2

Therefore for systems consisting in part of a reflex feature another is necessary. It is assumed that neutralizing condensers of a sort are employed, and no dependence placed upon inherent neutralization as the result of the various placements of the parts used.

The Roberts system of squeal neutralization as explained in the January, 1925, issue of RADIO BROADCAST will apply here.

For receivers of the standard r. f. type it will not be out of order to repeat the explanation of neutralization as recommended by the neutrodyne manufacturers.

First, tune-in a station to maximum signal strength. If possible tune-in a distant station as the neutralizing effect will be more manifest to the operator.

Then, remove the first tube, insulate one of the filament prongs with a slip of paper or spaghetti tubing so that it will not make contact with the filament socket blade, and replace it in the socket.

It will be noted that the signal will come in somewhat faintly. Carefully retune so that the signal will attain its loudest point, taking into consideration that it will not be as loud as before, because the tube is not functioning.

Now, with the aid of a rubber tipped pencil or other insulated object slowly slide the neutralizing tubing, or if it is a variable plate condenser, revolve it, until the signal vanishes. In some instances this condition may not be reached but at least the signal will decrease noticeably.

When this point has been reached, the insulation at the filament terminal may be removed and the operation repeated for the next tube.

HOW TO PREPARE PANELS FOR ASSEMBLY

IT MAY be said that in a majority of descriptive articles covering the construction of a receiver or other radio device, the preparation of the panel is lightly dismissed with the brief explanation that "the holes should be drilled according to the panel layout." In justice to this very important item, the few pointers that govern the proper preparation of a panel are described here.

To begin with, satisfactory tools are an essential not to be disregarded. A light hammer, dividers, center punch, scriber, square, and six-inch scale are entirely sufficient for the average work shop.

Wherever possible, dimensions given on panel layouts should be transferred to the back of the panel.

The front panel side should be selected for its freedom from blemishes and other marks although if it is to be grained there is no preference as to which is to be front or back.

With the square and scriber, lay off the dimensions making light scratch lines. At the intersections make the centerpunch marks. Don't cant the centerpunch, otherwise the mark may become off center.

In drilling the panel place the front side down against the top of the bench and clamp in position firmly. Then, with a small drill, drill out all the holes. After this is finished, the holes may be re-drilled to their correct size. Be sure to hold the drill in as perpendicular a position as possible. If it is desired that the drill not penetrate into the bench, then a board larger than the panel should be placed under it.

In graining a panel use a fine sandpaper or No. 00 emery cloth.

Rub up and down the length of the panel keeping the motion parallel with the panel edges.

When the desired appearance has been obtained the bakelite dust may be removed and a finish produced by rubbing the panel with an oiled cloth.

NOTES AND REFERENCES ON THE ROBERTS CIRCUIT

AS IS to be expected when a circuit like the Roberts spreads like wildfire, the many deviations from the original construction and "just that personal touch" have had accompanying them the innumerable troubles that befall any radio circuit.

A glance at the fundamental circuit Fig. 3 and the theoretical action depicted in Fig. 4 will at once appraise one of the fact that there are three main features of which it is comprised. And each one has its possibilities of bringing to the finished sets its own peculiar troubles. Intelligent tests may be conducted to determine its locality and causes.

The January, 1925, GRID briefly outlined the several places where trouble might be met.

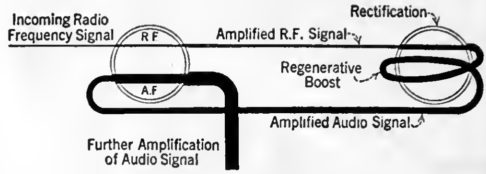


FIG. 4

The heart of the circuit is the two tuner units. Special care should be taken before assembly, to see that there are no open or short circuits in these coils.

Very often reversing the connections to the secondaries make the circuit function as should.

In the matter of reflexing the audio transformer should not be located too near the antenna coil unit. The coil units themselves should not be placed too near together and in all cases should be at right angles to each other.

Additional information on the Roberts circuit has appeared in the following pages of RADIO BROADCAST.

April	1924	Page	456
May	"	"	73
July	"	"	272
August	"	"	308
September	"	"	379–426–438
October	"	"	490
November	"	"	112
December	"	"	267
January	1925	"	511–524
February	"	"	711–721–746
March	"	"	875–909–930–931–939

CARE OF STORAGE BATTERIES

IT IS certainly true that you'll get out of a battery no more than you put into it.

A battery that is neglected lasts but a short while and in this day and age of radio modernity the time has not come when it is possible for us utterly to disregard battery expense.

Lead is subject to oxidation. Copper is subject to attack by sulphuric acid. In a battery, the terminals are of lead, and often after charging there is an excess of sulphuric acid covering the top of the battery jar due to spraying. Now, putting two and two together, the copper wire connecting cable will not always make perfect contact with the lead post due to the film of oxide on it. Also once the connection is on the post the acid causes corrosion which manifests itself in a light green slime covering the post and connector.

To insure a proper contact to the post it is well to scrape away the surface so that the

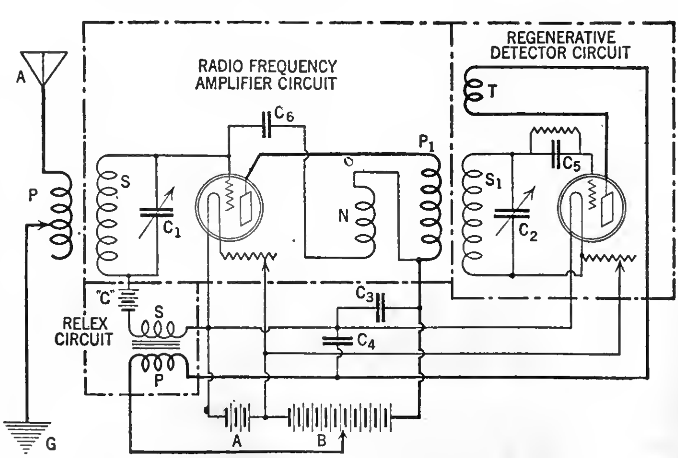
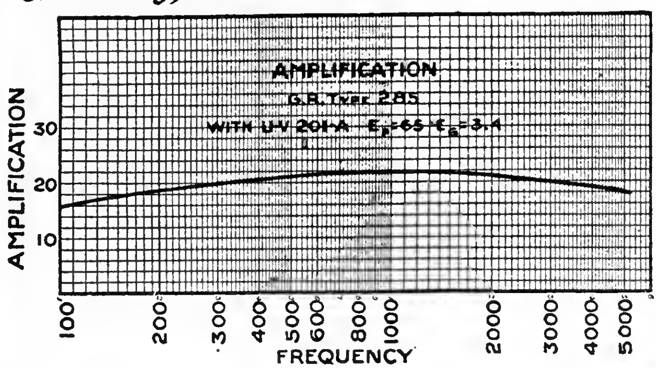


FIG. 3

The Outstanding Features of the Outstanding Transformer

Amplification Curve of the Type 285 Audio Transformer



The NEW GENERAL RADIO

Price $7

Type 285 Audio Transformer

Higher Amplification over the entire Audio Range.

THE marked superiority of the Type 285 Transformer is evident by its high and uniform amplification over the entire audio range. High amplification is attained by a turns ratio of 6:1. Ordinarily such a high ratio would lower the primary impedance and distort the lower notes, while the higher notes would be muffled or lost entirely by the effect of distributed capacity.

To offset these tendencies the core of the Type 285 Transformer is made of specially selected steel of high permeability, and the turns of the primary and secondary coils are increased to give a higher impedance and turns ratio. Consequently both ends of the curve are sustained, so that greater volume with better tone quality is the result.

More Natural Reproduction of Speech and Music.

TONES of high and low pitch, whether instrumental or vocal, in combination or individually, are reproduced with a clarity that pleases the most critical radio listener.

So great is the amplification produced by the Type 285 Transformer that one stage using a Type 285 gives a volume that is approximately equivalent to that produced by two stages using any average transformers. Seldom is more than one Type 285 necessary to produce good loud-speaker volume with a quality of tone never before realized in radio reception.

If you want the best there is in transformer design, the General Radio Type 285 should be your choice.

For Sale at all Leading Radio Stores ★

GENERAL RADIO CO.
Cambridge, Mass.

bright lead shows itself. To prevent corrosion often this cleaning process is applied: coat the post and connection liberally with ordinary vaseline.

Wipe the case and top of the jars dry of excess acid.

Keep the level of the solution one quarter of an inch above the plates.

Add distilled water when necessary but never add acid.

Do not bump the battery. Broken jar-units will result in a drop in capacity and voltage.

Keep the battery in a dry place. Once the wooden case becomes water soaked it is easy for the acid to attack and rot it.

Never short-circuit the battery to determine whether or not it's charged. Use a hydrometer.

In charging a storage battery do not charge it or discharge it at a higher rate than that specified on its nameplate.

The leads from the battery to the receiver should be strong and preferably of the double twisted lamp-cord type.

WAVE TRAPS AND HOW TO USE THEM

A WAVE trap is a remedy for poor tuning characteristics of a receiver. It is a cure but not a preventative.

However, the characteristics of many receivers are such that wave traps are really essential.

Briefly, a wave trap consists of a coil and variable condenser having the property to be tuned to or select a certain wavelength setting which it is desired to exclude from the receiver.

Usually a wave trap is required where the receiver

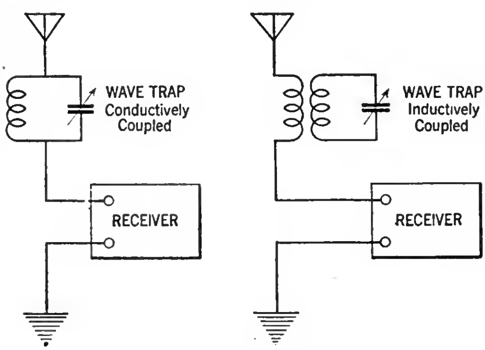


FIG. 5

tunes broadly permitting the reception of two or more signals simultaneously. The wave trap performs the functions of eliminating from the receiver circuit the undesired signal. The circuit is not unlike that of an ordinary receiver, the coil and condenser in parallel tune to the same wavelength range as the receiver.

Wave traps may be made according to several types as outlined in the circuit diagrams in Fig. 5, which also shows their proper connection.

The method of operation is as follows. The trap is tuned to the undesired interfering station, then the receiver is tuned to that station from which it is desired to receive.

HOW TO FIND RECEIVER TROUBLE

IN last month's GRID were listed three definite divisions where receiver trouble might arise.

The continuing four, listed below, are especially applicable to reflex receivers employing a crystal for rectification. Special attention must be paid to the selection of a crystal of merit, as this unit is really the heart of the circuit.

While, as has been said before, this information is especially intended for reflex trouble-shooting, much of it may be applied to a methodic trouble-detection system in many other types of receivers.

1.—General suggestions

A—Keep grid and plate wires separated and at right angles to each other.

B—Turn audio-frequency transformers so that their cores are at right angles to each other.

C—Separate tuning units so as to prevent reaction between them.

For reflex circuits employing crystal rectification the following notes may be observed.

2.—Howling

Be sure that the negative side of the A battery is grounded. When this is not done, howling or humming occurs. Howling is also produced by reversed leads to the primary of the audio frequency reflex transformer, and lack of use of suitable by-pass condensers across transformer secondaries when amplifiers are used.

3.—Crystals

Upon crystals really depends the successful operation of the receiver. Poor crystals will cause squealing, lack of volume, improper reflex action. partial rectification in the first tube, and broad tuning. About nine tenths of all the trouble in the reflex circuit can be attributed to a poor crystal. Get a good crystal!

4.—Selectivity

As stated above, poor crystals sometimes cause broad tuning. Then, too, location, nearness to local stations, etc., greatly effect sharp tuning. Several remedies for overcoming this fault are as follows: 1. Rewind the primary of the antenna coupler so that this circuit may be tuned to the incoming wave. 2. Construct a counterpoise of several wires either underneath the antenna near the ground, or, if your location is in a city, erect it in the basement of your house. A counterpoise consists of several wires, very similar to an ordinary antenna and well insulated. The counterpoise is used instead of a ground.

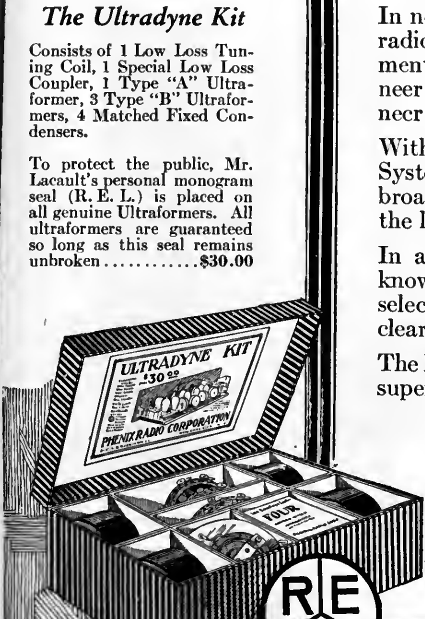
How to Build and Operate the Ultradyne

32-page illustrated book giving the latest authentic information on drilling, wiring, assembling and tuning the Model L-2 Ultradyne Receiver 50c

The Ultradyne Kit

Consists of 1 Low Loss Tuning Coil, 1 Special Low Loss Coupler, 1 Type "A" Ultraformer, 3 Type "B" Ultraformers, 4 Matched Fixed Condensers.

To protect the public, Mr. Lacault's personal monogram seal (R. E. L.) is placed on all genuine Ultraformers. All ultraformers are guaranteed so long as this seal remains unbroken $30.00



Heard Europe on a Home Built Ultradyne Model L-2

Arthur Bender, 116 East 2nd Street, Covington, Ky., had no trouble picking up European stations last week on his eight tube Ultradyne which he constructed himself.

—*Cincinnati-Enquirer*, Nov. 30, 1924.

Thousands have built it!

LIKE Mr. Bender, thousands have successfully built the Model L-2 Ultradyne and claim it the most wonderful receiver they have ever known for great distance on the Loud Speaker.

In no other receiver is found the "Modulation System" of radio reception—an outstanding radio engineering development by R. E. Lacault, E. E., A. M. I. R. E., Chief Engineer of this Company and formerly Radio Research Engineer with the French Signal Corps Research Laboratories.

With the application of regeneration to the "Modulation System" the Ultradyne is capable of detecting the faintest broadcast signal, regenerating and making it audible on the loud speaker.

In addition, the Ultradyne is the most selective receiver known. Regardless of close similarity in wave length, it selects any station within range—brings in broadcasting clearly, distinctly, faithfully.

The Model L-2 Ultradyne will do everything better than any super-radio operating under the same conditions.

Write for descriptive circular

ULTRADYNE

★ **MODEL L-2**

PHENIX RADIO CORPORATION

5-7 Beekman Street
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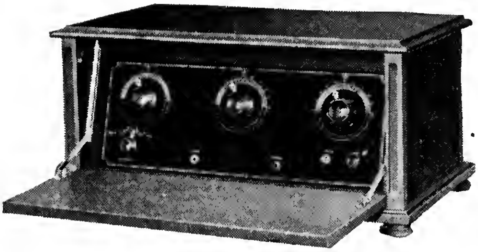
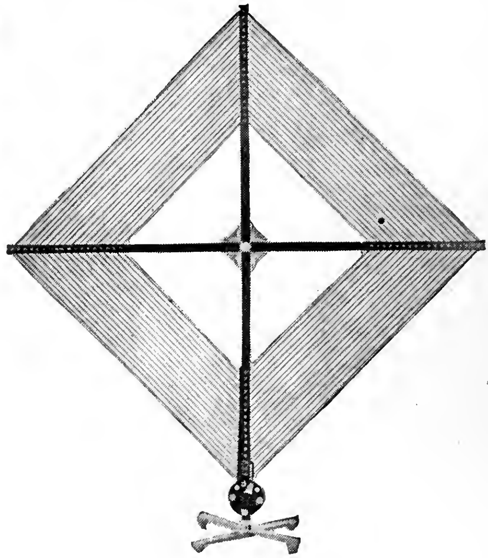
New Equipment



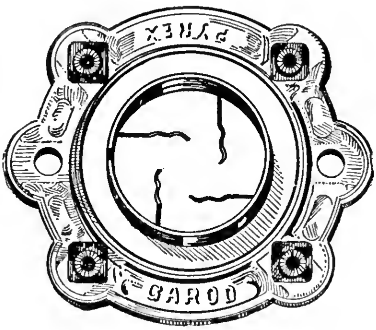
DAYOLA RECEIVER

A radio frequency receiver with good quality reproduction. It is enclosed in a cabinet of fine workmanship with a drop front, making it possible entirely to close the set when not in operation. Made by the Dayton Fan & Motor Co., Dayton, Ohio



LINCOLN LOOP AERIAL

The super-heterodyne receiver depends on the loop for signal pick-up. It is, therefore, very necessary that this function be accomplished efficiently. The loop illustrated here is of commendable construction and design. The tap off switch near the cast base allows variation of wavelength range. Made by the Lincoln Radio Corp., 224 No. Wells St., Chicago, Illinois



PYREX SOCKET

The base is of pyrex glass and the brass shell takes the tube base. The prong contacts are extended to allow direct soldered connections. Made by the Garod Corporation, 120 Pacific St., Newark, New Jersey

JEWETT MICRO-DIAL

The Micro-Dial, unlike some devices for micrometrical tuning, fits readily into virtually any set. It requires no special mounting to put it into operation and is not cumbersome. Made by the Jewett Radio & Phonograph Co., 5680 Twelfth St., Detroit, Michigan

THE ADAPTO RADIO CABINET

Is complete in detail as well as being a handsome piece of furniture. It will take any panel size up to 10$\frac{3}{4}$" high and 31$\frac{1}{2}$" long and combines loud speaker, easily accessible battery compartments, and a drawer for small items. Made by the L. R. Donehue Lumber Company, New Albany, Indiana

Among Our Authors

G. Y. ALLEN is too modest to send us his photograph for this page. We last recall seeing his picture in a group of Westinghouse engineers who were working under his direction in experimenting with radio reception in 1924 in the Hudson-Manhattan vehicular tunnel. Mr. Allen, who is engineer assistant to the manager of the radio division of the Westinghouse Company, says that he has lately become convinced that his interest in radio dates from the time that he was old enough to talk.

ZEH BOUCK at this writing had deserted his New York laboratory and forsaken radio and all its works for a vacation in Bermuda, which, as he says, is the nearest thing to a desert island he can find. We suggested a New York traffic tower as the latest thing in solitude, but he turned that down because he was afraid that somebody might mistake one for a mast and string an antenna on it. His article in this number of the magazine deals with a subject that we all feel is highly important.

ZEH BOUCK

"MY ACTIVITIES in radio," writes Mildred Weinberger," have been largely vicarious, for I married radio." Her husband is Julius Weinberger, a research engineer for the Radio Corporation of America in charge of broadcasting station design. The scope of her article may be better understood when we know that Mrs. Weinberger's hobbies and recreations "have been tied up closely with plays: writing and producing them. I have acted and often been the general handy man who makes something out of nothing", she writes.

B. F. MIESSNER, who is contributing a series of articles on sound and its relation to radio, is probably known to some readers by his book *Radio Dynamics* which was brought out by Van Nostrand, as well as for his invention of the Electric Dog which is more scientifically known as Automatic Heliotrophic Machine.

KEITH HENNEY is a new member of the technical staff of RADIO BROADCAST and recently completed three years of research under Dr. E. L. Chaffee at Cruft Radio Laboratories, Harvard University.

HARRY DIAMOND has been "in radio" since his undergraduate days at Massachusetts Institute of Technology. "Radio," says he, "has always been my hobby since the days of the spark gap (I often feel that some do not know that those days are over). My present position allows me considerable chance for radio research, but I have not as yet succeeded revolutionizing the art." Mr. Diamond is an instructor in Electrical Engineering at Lehigh University.

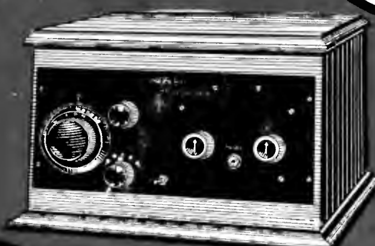
JOHN EDDY got his first thrill as a schoolboy in London at the time of the *Titanic* disaster. "Then I wound a coil on a two-by-four and tried to copy time signals from the Eiffel Tower," he writes. "I operated amateur stations 2AKN, 3FS, 2JE, and finally 8NI at Ithaca, New York. At fourteen, I held a commercial operator's license. During the summer vacations from school and college, I have enjoyed trips taken as radio operator to Cuba and Gulf of Mexico ports and to the West Coast. I can't decide whether radio has cursed my life or blessed it."

MILDRED WEINBERGER

HAROLD S. FRAINE is a member of the advertising staff of RADIO BROADCAST and spends most of his time tracing scents in the radio forests of New York City. He has a wide acquaintance among those who manufacture and sell things radio. His work in the International Radio Broadcast Tests has made him a popular person indeed, for he has many valuable facts about the radio likes and dislikes of the American public now at his figurative finger tips.

THE NEW CROSLEY 52-SPECIAL

$35



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Of course, the popular Crosley 52 will be continued. It has given uniformly satisfactory loud speaker service in all parts of the country. Continual coast to coast reception and even foreign stations on the loud speaker have been frequently reported. You can purchase a Crosley 52 or 52 Special from most any good dealer. All Crosley Radios are licensed under Armstrong Regenerative U. S. Patent 1,113,149. Write for Catalogue.

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